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OF THE

INDIAN IRRIGATION COMMISSION,

1901-1903.

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INDIAN IRRIGATION COMMISSION,

1901-03.

APPENDIX.

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INDIAN IRRIGATION COMMISSION, 1901-03.

SELECTED EVIDENCE.

PUNJAB.

Mr. P. J. **Fagan**, Revenue Secretary, Punjab Government.
(Lahore, 29th October 1901.)

Mr. P. J Fagan.

Memoranda by witness—

I.—Irrigation in Montgomery district (not printed).

II.—Shah Nahr Canal, Hoshiarpur district (not printed).

III.—Imperial and Provincial Canals (Financial).

1. The two main classes into which Irrigation Works are divided for financial and account purposes are :—

(1) Productive Works, dealt with under Budget Heads XXIX and 42, 49.

These are also called Major Works. 49 is a major head of capital outlay under expenditure not charged to Revenue.

(2) Minor Works, dealt with under Budget Heads XXX and 43; the latter is a head and expenditure charged to Revenue.

There is, however, a Class (3) Protective Irrigation Works, the cost of the construction of which is dealt with under Major Head 35, subordinate to Famine Relief and Insurance, such expenditure being chargeable to Revenue. These Protective Works may be classed as Major Works or Minor Works.

2. Works classed as Productive (1) above are, in the first instance at any rate, wholly Imperial. The effect of the rules in Chapter XV of the Public Works Department Code is to forbid the construction of a Productive Work directly from Provincial Funds. See specially articles 2124—2128, 2130. Local Governments, however, may play an important part in the initiation of such works. See articles 2136, 2139—2148, 2151 and 2152, Public Works Department Code, and the financial arrangements during construction are to some extent under their control (articles 2146—2150). Article 2153 contemplates the provincialization of Productive Works. The last article and articles 2151 and 2152 reproduce the order contained in Government of India, Finance, Resolution No. 2009, dated 23rd March 1878. But the operation of the latter two articles has been rendered somewhat easier for Local Governments by the recommendations contained in Volume II, Chapter XI, Section E, page 289 of the Report of the Finance Committee of 1886 (*vide* paragraph 4 of Financial memorandum by Mr. Laville, Assistant Secretary, Financial, to Punjab Government, and the papers quoted by him). The system of provincialization has been adopted in the case of the Jhelum canal and of the Sirsa branch of the Western Jumna canal, but it will not take effect until the expiration of ten years from the opening of these works, or sooner, at the option of the Local Government. At present all direct receipts from Major Irrigation Works are wholly Imperial under the terms of the current Provincial contract. It is, I think, for consideration whether some of the existing Major Irrigation Works should not be provincialized on the lines laid down in paragraph 8, Chapter XI of the Report of the Finance Committee, quoted above.

The Major Works at present in existence are :—

I.—Swart River Canal (Protective).

II.—Western Jumna, including Sirsa branch (Productive).

III.—Bari Doab Canal (Productive).

IV.—Sirhind (Productive).

V.—Chenab Canal (Protective).

VI.—Jhelum (Productive).

VII.—Lower Sohag and Para (Productive) (Inundation).

VIII.—Sidhnai (Productive). (Not perennial.)

3. Minor Irrigation Works are (*a*) Imperial, (*b*) Provincial. The financial rules regarding them are contained in Chapter XIX of Public Works Department Code, articles 2204—2211. They can be constructed by Local Governments subject to the above rules and to those contained in Chapters XVI and XVII.

Funds for Minor Irrigation Works are provided from revenue, and not from loans; and in the case of Imperial Works, at any rate, this appears to lead to curtailment of the means required for extension and improvement. See paragraph 2 of a Memorandum on Irrigation of River Valleys by the Honourable Mr. J. Wilson, Settlement Commissioner. The following figures for the last two complete years illustrate the point :—

	Year.	Direct receipts.	Direct expenditure.		
			Capital.	Working expenses.	Total.
		Rs	Rs.	Rs.	Rs.
Major Irrigation Works (Imperial).	1899-1900	1,26,31,784	44,07,371	38,78,492	83,75,868
	1900-1901	1,36,37,480	45,16,883	40,40,843	85,57,726
Minor Works (Imperial).	1899-1900	8,91,368	54,099	13,31,906	13,86,005
	1900-1901	8,09,291	40,861	13,25,839	13,66,700
Minor Works (Provincial).	1899-1900	41,128	1,500	21,316	29,836
	1900-1901	1,85,735	14,181	73,060	88,567

The Minor Imperial Irrigation Works of the Province are :—

I.—Upper Sutlej Inundation Canals.

II.—Lower Sutlej and Chenab Inundation Canals.

III.—Indus Inundation Canals.

IV.—Shahpur (Imperial) Inundation Canals.

V.—Muzaffargarh Inundation Canals.

VI.—Ghaggar Canal.

The Provincial works (Minor Works) are detailed in the statements appended to Mr. Laville's note, and will be dealt with below.

4. Of the Minor (Imperial) Irrigation Works Capital and Revenue Accounts are kept [article 2205 (*a*), Public Works Department Code] for all except No. V above, for which only Revenue Accounts are kept. There should therefore, as regards proposed extensions and improvements, be no difficulty in forecasting financial results. Article 2209, Public Works Department Code, provides for further capital expenditure on this class of works, which, so far as this Province is concerned, are all inundation canals. The point for decision is whether such works are sufficiently profitable to justify the expenditure of borrowed capital on them. That they have been so in the past, there can, I think, be no doubt. At present they have to complete with the large perennial canals, and this will be increasingly the case in the future as the contemplated large schemes are carried out; still there must, I think, always continue to be a fairly wide field for irrigation in the Punjab riverain tracts, and reasonable expenditure of borrowed capital or more extensive expenditure than at present of funds derived from revenue will, I believe, be found remunerative; and beyond this there is the consideration of our moral obligations to the riverain landowners whom our perennial canals injure directly, whatever may be the indirect benefits which they derive from them.

5. Mr. Laville has dealt with the subject of Provincial canals in his Memorandum, and he has given most, if not all, the information required by paragraph 3 of the Memorandum issued by the Commission. There is little for me to add. Further information is also available in the Irrigation Department Notes.

6. The limitations which exist in regard to the expenditure on the construcion of Irrigation Works by Local Governments have been indicated in the opening sentences of paragraphs 2 and 3. Such works must be Minor Works and paid for from Revenue.

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At the time of passing the last Provincial contract in 1896-97 the Government of India, in response to an appeal from the Local Government, allowed the estimate of prospective annual expenditure under Head 43 to be fixed at the prospective total amount of annual receipts under Head XXX, *i.e.*, Rs. 1,18,000 in place of an estimate of Rs. 72,000 based on the actual expenditure of the period of the previous contract; but, as noted by Mr. Laville at the end of his notes, the Punjab Government has not been able to take advantage of this concession owing to unforeseen expenditure on plague and famine. I agree with Mr. Laville in thinking that the Provincial contract system does not, on the whole, operate to discourage the application of available Provincial surpluses to the construction of Minor Irriration Works. It is to the interest of the Provincial Government to so utilize such surpluses, otherwise they may have to be surrendered at the end of the period of the contract; or absorbed in the arrangement of the next contract. This last consideration would tend, I think, to discourage the undertaking by the Local Government of large schemes which may take two or three years to complete, inasmuch as the contract period may terminate in that interval and the surplus Provincial Funds intended for expenditure on the work disappear in the manner noted above. I think that it would be well that at the time of passing a new contract the existence of any such large current Provincial Irrigation Projects should be borne in mind by Government of India.

7. On the question whether it is advisable to apply Provincial Funds to the construction of Irrigation Works my reply would be that it certainly is so in the case of Minor Works. For Major Works borrowed capital is needed, so that the present arrangements referred to in paragraph 2 above must be maintained so far as they are concerned. Even in the case of a local debenture loan the Local Government acts merely as the Agent of the Government of India (article 2126, Public Works Department Code).

---

1. *Q.* (*The President.*)—I understand, Mr. Fagan, you are Financial and Revenue Secretary to the Government of the Punjab?—Yes.

2. *Q.* What districts have you served in in the Punjab?—In Montgomery.

3. *Q.* Have you had any experience of famine relief works?—No.

4. *Q.* You doubtless had a good deal to do with District Boards?—Yes, a fair amount, more especially in the district of Hoshiarpur.

5. *Q.* Do you think that they could be usefully employed in the control of minor canals?—No. My impression is that District Boards are not qualified to deal with irrigation questions. I think they could only deal with them under professional advice from the Irrigation Department. They have not the means or *personnel* needful for running canals on approved professional lines. The Irrigation Department is the proper agency, and the District Board might content itself with nominal control.

6. *Q.* But are there not a good many useful minor irrigation works which practically want little or no scientific supervision?—In Montgomery there are a good many. I did not, however, have much to do with them in that district, but Mr. Kitchin will be in a position to say more about it. I understand from him that, partly owing to the fact that District Board funds are run down, they really have not the means to carry them on. They were originally constructed by the District Board, and the alignment in many cases is wrong and impairs their efficiency. I don't think District Boards can do much except perhaps merely as pioneers. They cannot manage works on anything like a scientific system.

7. *Q.* I suppose their powers of co-operation are not very great?—My experience has been that it is rather difficult to get District Boards to take much interest of their own accord unless they are suitably induced.

8. *Q.* I understand generally that in the Punjab *rabi* is the chief crop?—Yes, in most districts; certainly in Montgomery.

9. *Q.* What is the rainfall of that district?—The average is about 9 to 10 inches for the last ten years. For the last two years there has been practically nothing at all.

10. *Q.* Then the *kharif* crops raised in that district are from the inundation canals?—Yes.

11. *Q.* They don't trust to rainfall?—No, except in old beds of nullahs which receive drainage from higher levels.

12. *Q.* What are the chief *kharif* crops?—Cotton is the main crop, a little maize, a large amount of *charri* for fodder, and a certain amount of *moth* and pulse.

13. *Q.* Is there much *rabi* grown in Montgomery district?—A considerable amount; much of it helped by inundation. When they get the first water from the inundation canals in September, the ground is ploughed, and sowing takes place later on.

14. *Q.* Then the inundation canals generally dry up?—Yes.

15. *Q.* Do they count on the cold weather rains for ripening the crop?—Yes, and also on wells.

16. *Q.* Would there be a great extension of *kharif* if more water were given?—Yes. They probably would extend cotton cultivation. I don't think all the water would be devoted to extension of *kharif*. it would be devoted to the extension of *rabi* as well.

17. *Q.* I suppose cotton is per acre the most valuable crop?—Yes; I think so.

18. *Q.* You say wells are always used to supplement irrigation?—Yes. It depends a good deal on the relative efficiency of the canals. Where the well supply is a low one, I would say the canal helps the well.

19. *Q.* It must require a large number of wells to maintain irrigation started by the canal. What is the irrigation per well?—I suppose in the Sutlej Tahsils it would run to say thirty acres with plenty of canal water to start with and winter rains.

20. *Q.* Supposing inundation canals ran dry by 1st December?—They would then depend on wells altogether. Provided they had good moisture for sowing and fair winter rains, they can do that.

21. *Q.* Are they *pakka* wells?—Yes. Practically all of them. There are a certain number of *Jhelárs* on the river bank for lift irrigation and also on watercourses.

22. *Q.* Are the agricultural classes generally in a position to go on making wells? Do they want help from Government?—They take a certain amount of *takavi* from Government in Montgomery.

23. *Q.* Do you consider any change necessary in the matter of giving assistance?—I think if the *takavi* procedure were simplified and the borrower could get his loan more promptly, it might encourage their resort to Government assistance, and I think now, seeing the new legislation we have, they will probably resort to it more.

24. *Q.* What assistance is it reasonable for Government to render?—In Montgomery I don't think there is much chance of extension, unless canals are also improved and extended. There are many wells which receive no help from them. They depend for that on rain, and this is not a very profitable form of agriculture. Extension of well irrigation must wait upon that of canals.

25. *Q.* It is proposed that the Bari Doab canal should command that district?—Yes; mainly.

26. *Q.* The Shah Nahr canal in Hoshiarpur is under the Deputy Commissioner?—Yes, he has been formally appointed Executive Engineer under the Canal Act. So far as is practicable, distribution is largely done by the Manager. Though Government has taken over the canal, so far as is possible it is run by the people themselves.

27. *Q.* Would you suggest a greater interference on the part of the Canal Department in the canal?—I have noted points, but I think on the whole, as far as actual management goes, it would be better to run it on the present lines. When it comes to undertaking extensions—I mean substantial extensions—then I would suggest it being under more scientific control.

28. *Q.* It would be easy to lend an Engineer's services?—Yes.

29. *Q.* But would you suggest it being put under more rigid rules?—I think it is not necessary.

30. *Q.* Would it be popular?—I think not. The canal irrigation is not a burning question. Of course, we have a fairly good rainfall, so I think under the circumstances perhaps any further interference would not be advisable.

31. *Q.* You refer to a Minor Canals Bill?—That is a Provincial measure. It has been sent to us by the Government of India for amendment, and requires a good deal of redrafting. The main lines are to enable

Mr. P. J. Fagan.

Government to assume the management and control of private canals under reasonable terms. It will be some time before it becomes law.

32. *Q*. You think something of the sort necessary?—Yes.

33. *Q*. Turning to your Montgomery experience, I see in paragraph 3 of your note you suggest, as far as your experience goes, that much could be done for greater security to irrigation by improved head-works and weirs?—Yes.

34. *Q*. Of course, that would entail a very heavy outlay?—The weirs would certainly.

35. *Q*. Are there any masonry head-works?—Not to these canals.

36. *Q*. You say in paragraph 13 of your memorandum that the abandonment of wells is due chiefly to migration of tenants. Do you mean that the land goes out of cultivation till a new tenant is procured?—Yes. In the Chenab Colony there is a great demand for land, just as in Montgomery there is rather a great demand for tenants.

37. *Q*. The population is very sparse?—Yes, in the cultivation which adjoins the Chenab Canal. The Chenab Canal had great effect in taking away tenants.

38. *Q*. Then if the improvement of the Bari Doab Canal is carried out, would that remedy the state of affairs?—Yes, for a time; for tenants would pour into Montgomery. The shortage of tenants would still, however, continue until the tract filled up.

39. *Q*. It would throw the interior of the distrct into better condition; of course, there would be perennial irrigation?—I think tenants would be attracted away to the new canal.

40. *Q*. But, on the whole, the effect of the new canal would be to bring the greater part of the Central Bari Doab under cultivation. It would be doubtful whether the canal would pay?—As far as the district itself went, certainly.

41. *Q*. I suppose it would increase the food supply?—Yes.

42. *Q*. (*Mr. Higham.*)—Do you think there would be any objection on the part of the people to the amalgamation of the water-courses proposed in your memorandum?—I think there would. Mr. Bellasis, the Executive Engineer, who undertook a good deal of that with a certain amount of success, met with considerable objection from the people. They like two water-courses, which prevent possibility of dispute.

43. *Q*. Whatever has been done, villagers have not had to pay for it?—Yes, they have, for those constructed at the cost of Government. Those are village water-courses.

44. *Q*. When they are amalgamated, do villagers have to do them or Government?—It was just being undertaken when I left. I understood a number would be amalgamated. They were told in future water would not be supplied until this had been done.

45. *Q*. At their own expense?—With recovery, of course, from them.

46. *Q*. That would make it unpopular?—Yes, exactly.

47. *Q*. The inundation canals have suffered from the working of the Sirhind Canals?—I have heard complaints on that score. I do not know that it has been satisfactorily established.

48. *Q*. As far as the Bari Doab is concerned?—I can't say I have gone into the question very fully, but I don't think anything to a very remarkable degree as far as Montgomery is concerned.

49. *Q*. When were you settling the district?—From the beginning of 1894 to 1899.

50. *Q*. How did the irrigation of these canals compare with what had been recorded in the previous settlement?—There was an increase as compared with the previous settlement made in 1872-73.

51. *Q*. Do you know if there was an increase in the latter half of the settlement period?—I could not say without looking up figures. I think there was a fairly uniform increase. One has to bear in mind that the Lower Sohag and Para are new canals. Of course, that would make comparison still more difficult.

52. *Q*. What is the extent of the salt land?—I could not say what the area is around Montgomery itself. There is a very considerable extent along the old high bank which bounds the central portion of the district and below that.

53. *Q*. It is called *reh*?—Yes.

54. *Q*. The salt would probably be washed out by irrigation?—I have not had experience of it, but, without some sort of subsoil drainage, it would not be washed out permanently; it would be washed down and with evaporation would come up again.

55. *Q*. Have you had any famine relief work in the Montgomery district?—Not in my time. There was a scarcity at the end of 1897-98, and an attempt at test works, but people did not come to them, and no famine relief works were opened. The people of the distressed part went across the river to the Chenab Canal where they either cultivated themselves or got temporary cultivation from Government.

56. *Q*. (*Mr. Wilson.*)—I see you estimate that the cost of a *pakka* well varies from Rs. 250 to Rs. 550?—Yes, taking the whole district.

57. *Q*. What is the average cost of a *pakka* well?—The depth varies very much. I should say from Rs. 250 to Rs. 300 in the riverain tracts.

58. *Q*. What would be the increase of produce due to the construction of such a well if commanded by a canal?—So far as the revenue rates go, the revenue would increase from 10 or 12 annas per acre to Rs. 1-6-0 or Rs. 1-7-0.

59. *Q*. You mean the net income of revenue to Government?—Yes.

60. *Q*. What benefit would Government derive in increase of land revenue from the construction of such a well costing Rs. 300 in such a tract?—I should say, on an average, 10 annas an acre cropped to Rs. 1-6-0; that is speaking of the Sutlej Tahsils.

61. *Q*. What would be the area cropped by such a well?—Assisted by canal irrigation, on the average, from 25 to 30 acres would receive well water.

62. *Q*. The land revenue would be increased by Rs. 18; 12 annas would be an outside estimate of the average?—Yes.

63. *Q*. How soon would Government obtain that increase?—Not till the next settlement. A new well being constructed, the cultivation which got canal water would pay the canal rate, but would not pay anything more on account of well irrigation.

64. *Q*. Would Government necessarily get it at the next settlement and what about the protective lease?—It would not get it at all events until the current settlement had expired, nor until the expiry of the protective lease.

65. *Q*. Government would then obtain an increase of 18 rupees of land revenue from each well constructed by a private owner?—Yes.

66. *Q*. Are occupier's rates charged on the Sutlej Canal?—Yes.

67. *Q*. Are they charged on the matured area?—Yes.

68. *Q*. Would the construction of a well lead to an increase in the amount realizable as occupier's rates by increasing the matured area?—Yes.

69. *Q*. Could you give any estimate?—I should not like to give one straight away.

70. *Q*. Land revenue rate is also assessed on canal irrigation; that is, on the area sown?—Except in years of widespread failure of canal supply or an extensive failure of winter rains. In that case it was arranged that remissions should be given for failed crops.

71. *Q*. Still, generally speaking, the canal rate is assessed on the area irrigated with the help of canal water, but increased by the construction of a well?—To some extent; because there would be a feeling that if a well is there, it would help to ripen the area sown.

72. *Q*. The construction of a well would lead to an increase of the area matured. The financial benefit the Government derives from it is not only Rs. 18?—Rs. 18 is an outside limit.

73. *Q*. And in addition to that there is an imme- it perhaps at Rs. 15 to Rs. 18.

74. *Q*. And in addition to that there is an immediate increase, not inappreciable, from occupier's rates?—Yes.

75. *Q*. If that is so, it is a very profitable financial transaction to have new wells made?—Yes, where there are canals to assist.

76. *Q*. Would it not be financially profitable to Government to incur a certain amount of expenditure in order to get more wells made in such tracts?—I think so.

77. *Q*. Is there any difficulty in getting Government money to lend out as *takavi* advances? Is the grant, given by Government, sufficient for the advances desired?—As far as the districts of Montgomery and Rohtak are concerned, I have not experi-

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onced difficulty. At Hoshiarpur there is not much demand for well construction. In certain districts there has been difficulty, but I have not exact figures.

78. *Q.* Have you seen Mr. Laville's figures? The Punjab Government have cleared Rs. 40,000 a year on its *takavi* system. That is net profit to the Provincial Government. On the present footing, would it not lead to further profit if the amount granted were largely increased?—Yes.

79. *Q.* Would it not be advisable to reduce the rate of interest so as to absorb the net profit which Government makes?—Taking the total loans of all kinds into account, there is nothing available. There is a deficiency.

80. *Q.* In the Montgomery district you say that a number of wells have been deserted, especially on the Ravi?—Yes.

81. *Q.* Do you think they will be taken up again?—I think that, with the assistance of the District Board Canals, they might be set to work again.

82. *Q.* Is there much room for improvement in the Montgomery district?—On the Lower Sohag and Para there is considerable room for more wells in canal-irrigated land.

83. *Q.* If *takavi* were allowed without interest, would it add much to the extension of wells?—Yes. One of the main difficulties in the past about the wells has been that the zamindar goes to his baniah for his domestic expenses, and the baniah with this grip on him compels him to come for agricultural loans also. I am certain, if he could get loans without interest, it would not be any the less inducement for him to go to Government.

84. *Q.* Do you think that on the whole it would be advisable for Government to grant *takavi* for the construction of wells free of interest?—As far as extension of cultivation and profit to Government go, I don't think there can be much doubt about it.

85. *Q.* In your statement here you say that the Sohag and Para Canals have earned a net annual profit in the last three years of 10 to 14 per cent. Do you think that they are given sufficient credit for what they bring in to Government?—They have not in the past, but since the new assessment I think they get a fair credit for the income they actually create; and they should continue to do so, for the occupier's rates are revised from time to time.

86. *Q.* Are they given any credit for cesses?—No.

87. *Q.* Should they not be given credit?—Yes, theoretically they should.

88. *Q.* As far as those two tracts are concerned, if it were not for inundation canals, there would be no cultivation at all?—No.

89. *Q.* The net profit of 10 to 14 per cent. is not an exaggeration?—No.

90. *Q.* It is a financial profit to Government?—It varies from year to year. Lately they have not shown a very high rate of profit.

91. *Q.* They are very profitable as a speculation?—Yes.

92. *Q.* In the Montgomery district do you think that canals could be further extended so as to give something approaching this profit?—Yes. There will be very keen competition. I mentioned this point in my financial memorandum. There is still a very considerable field for a fairly remunerative investment of Government money. But the canals have now to compete with perennial canals, and we can't afford to lose sight of the fact that an inundation canal alongside a perennial canal can't be as profitable as an inundation canal with a perennial canal nowhere near it.

93. *Q.* When you were settling the Montgomery district, had the Chenab Canal been developed?—Most of the time I was settling Montgomery at the beginning of 1894 and end of 1898.

94. *Q.* As compared with things before, had the tracts improved or the reverse?—They certainly did not improve.

95. *Q.* Owing to what cause?—Largely owing to decrease in *Sailab* and still more to desertion of tenants and owners to the Chenab Canal.

96. *Q.* There was a decrease in the *Sailab*?—Yes; largely due to the Bari Doab Canal, but also, I think, to the channels of the river having straightened.

97. *Q.* What is the condition of the Ravi villages now compared with when you settled them a few years ago?—They have deteriorated still more.

98. *Q.* What has been done by Government to make this up to them in the way of assessment?—The assessment has been made more fluctuating. What fixed assessment there was has practically been abolished and canal irrigation has been extended to the high lands above the river, and I believe considerable grants of land have been given to the people on the Government land.

99. *Q.* Does that completely compensate them for the injury they have suffered from the opening of the large canals?—Yes.

100. *Q.* Does it put them in as good a position as they were before?—Probably—pecuniarily; but they (the zamindars) prefer flood irrigation and easy cultivation.

101. *Q.* Do you think that anything could be done to restore the prosperity of the riverain villages?—I think that, if the inundation canals, at present under the District Board, were improved, it would to some extent improve their condition.

102. *Q.* Is the District Board in a position to improve them?—I think not. From Mr. Kitchin's memorandum it appears that their income largely depends on fluctuating income, and it has fallen very low; the District Board is practically bankrupt.

103. *Q.* Is the Provincial Government likely to advance funds for improving these canals?—That depends largely on plague and famine, which have taken away all our surplus funds.

104. *Q.* Are there not sufficient funds for it from borrowed capital?—I doubt it.

105. *Q.* How many lakhs would be required?—It would be difficult to say. I doubt whether it would pay to borrow for the Ravi canals; for the Sutlej it would probably pay.

106. *Q.* (*Mr. Rajaratna.*)—In the villages just referred to, when was the assessment revised?—The new assessments were revised in 1894, then I had to revise them again at the end of 1895, and even since then I have extended the area of fluctuating assessment.

107. *Q.* What reduction was made in assessment?—The fluctuating assessment depends on the area matured.

108. *Q.* What reduction was made in the rate per acre?—You can't consider the rate per acre; the actual area varies very widely.

109. *Q.* Was no relief granted?—A great relief was granted because the former assessment was fixed.

110. *Q.* What was the proportion of matured area compared to the former area on which the assessment was fixed?—In the Gugera Tahsil in 1856 the cultivated area was 86,000 acres; at the settlement of 1872-73 it was 66,000 acres; in 1896-97 shortly after my revision it was 48,000.

111. *Q.* The assessment on those?—I have not got the figures just now. The settlement of the first was Rs. 71,000; at the revised settlement of 1871-72 it was Rs. 78,754, then it was Rs. 58,000. The second one is 48,000 acres, Rs. 58,000; on 6,000 acres no relief has been given. The Rs. 71,000 was fixed; the Rs. 58,000 was a largely fluctuating assessment; it was not a fixed assessment.

112. *Q.* I don't see what relief has been given?—The relief is in the elasticity. In the old system they paid whether there was a crop or no crop, subject to certain reductions in the case of continuous failure.

113. *Q.* (*Mr. Ibbetson.*)—I understand what you really mean is that the area under cultivation has been decreased, not that the area actually cultivated has deteriorated; you give full relief as compared with the reduction?—Full relief as far as the assessment goes.

114. *Q.* Might you not go further? The cultivated area which you settled at a fixed assessment included fallows, whereas the area on which you take your fluctuating assessment is the matured area?—The figures I gave were for that area. I have the fallow area as well.

115. *Q.* (*Mr. Rajaratna.*)—You refer to wells supplementing canal irrigation. Are such lands liable to pay the same rate as other lands not possessing the advantage of a well supply?—The land that does not have a well and merely depends on canal irrigation merely pays as far as canal revenue goes. If it has a well in addition, it pays canal advantage rate for the area over which the canal water is taken and something in addition for the well. I am taking the case of an old well in which the period of exemption has expired. Of course, if it is a new well dug during the term of assessment, up to the time when the protective lease expires, there can be no increase.

116. *Q.* Supposing he sinks a well two years before settlement?—He will then get 18 years before the new assessment is introduced.

117. *Q.* The assessment will be framed at the end of two years?—It will not be enforced until 18 years have expired.

118. *Q.* Are there many wells independent of canals?—Comparatively very few. I could not give exact figures. They are in what we call 'Barh' tracts outside the river valley.

119. *Q.* (*The President.*)—I understood you to say the owner of a well in the riverain tracts depends on the canals, and, were it not for the canal, would not think it worth his while to make a well for irrigation?—That is the case.

120. *Q.* Can you give the number of wells in the 'Bar'?—I could not give exact figures; the wells are very scanty compared with wells in the riverain tracts that get assistance from the canal.

121. *Q.* (*Mr. Ibbetson.*)—To come back to District Board management; supposing the financial difficulty can be got over, would you then say that District Board management should be recommended or not as compared with the Government management as regards efficiency, impartiality and popularity?—We should gain by District Board management in popularity, but lose in efficiency.

122. *Q.* By popularity I don't mean popularity with the District Board, I mean with the people?—I think we should probably gain; we should have to depend on the Deputy Commissioner being constantly in a position to supervise matters and settle disputes on the spot.

123. *Q.* Why should that be a more popular management?—It would certainly be a better means of irrigation.

124. *Q.* As to impartiality, have you ever heard anything as regards the distribution of water under District Board management? Is there a possibility of one man being better supplied than another?—I think there is a great possibility. It would have to be watched and checked very carefully.

125. *Q.* Have you heard any complaints of that sort?—I have not had practical experience of working a District Board canal. In Hoshiarpur I had complaints on that score, although, of course, many of them were without foundation.

126. *Q.* On the whole, would you prefer it or not?—I think there is a useful field for District Boards in the management of works which are not of any great importance. In a way, I regard a District Board as a pioneer.

127. *Q.* It is, I understand from Mr. Kitchin's note, in practical management far from successful. You will see a reference to this point in paragraph 9 of his note. Have they a very considerable area of irrigation?—Yes. The Mamunke embankment came to grief in the last flood.

128. *Q.* How does the Deputy Commissioner manage? Is it nominally management by the District Board, but really by the Deputy Commissioner?—Yes. I ought to explain that Mr. Kitchin came to the district before I left.

129. *Q.* What legal powers have the District Board and the Deputy Commissioner in the management of the works?—None.

130. *Q.* Will the Minor Canals Act give them any power?—I don't think that the Minor Canals Act will be applied to District Board canals.

(*Mr. Wilson.*)—It was certainly intended that it should.

131. (*Witness.*)—The thing is at present rather in the air; the Act is to be redrafted. At present it applies only to canals taken over by Government.

132. *Q.* (*Mr. Ibbetson.*)—Is it advisable that legal power should be given?—Yes. I don't know whether it is necessary for District Boards to have very extensive powers, though they should have a certain amount of power in settling disputes.

133. *Q.* I notice that Mr. Kitchin condemns private management absolutely. Do you agree?—Yes.

134. *Q.* Why is it necessary that Government should take over private canals?—I think they should be taken over in the case of mismanagement.

135. *Q.* Do you think that any legislation giving an owner power to recover or allowing Government to recover for him is necessary?—It is not so much a question of recovery as of unfairness and quarrels among proprietors. There is a great diversity of interests. On the Mahdikhan Canal there is no difficulty in recovering dues.

136. *Q.* You say private *chars* are very numerous on the north of the Ravi; will they be superseded if there is large increase of irrigation?—There would be if these canals were extended.

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137. *Q.* What is a *char*?—It is simply a cut from a river.

138. *Q.* When you say "private," do you mean owned by individuals or by villages?—Some by individuals and some by villages.

139. *Q.* Taken by men who have grants of land?—Yes.

140. *Q.* How do they work?—With a good flow from the river they have managed to do a very considerable amount of irrigation.

141. *Q.* Is the work of construction well done?—Yes.

142. *Q.* It is done cheaply?—The cash spent is not extensive.

143. *Q.* As regards maintenance, are there any difficulties about that?—No, the silt is cleared by the owner. Where the *chars* belong to the village, the length is distributed according to the level of the *chars*, and each shareholder is responsible for a certain length.

144. *Q.* Does that work well?—Yes.

145. *Q.* You have never heard of any pronounced difficulties about them?—Not on the private *chars*.

146. *Q.* Is there any outlay?—Very probably there would be a certain amount. It would be lessened by *takavi* grants.

147. *Q.* Do you think that, if Government extends irrigation from inundation canals considerably, the extension of the wells necessary to supplement it will keep pace with it?—There may be difficulty about capital.

148. *Q.* What is the life of a well?—Forty to fifty years with a certain amount of repair required in that time.

149. *Q.* (*Mr. Wilson.*)—Are they built with lime and masonry?—Yes.

150. *Q.* (*Mr. Ibbetson.*)—I suppose that, when the Lower Sohag and Para Canals were made, the same difficulty was experienced as regards the desertion of villagers. They went off to the better supplied lands?—I don't think there was any noticeable migration.

151. *Q.* You have no experiences to give?—In the years 1872 and 1873, when these inundation canals were taken in hand, there was a drain of cultivators from the Upper Sutlej riverain, but that had certainly righted itself when I came in 1895.

152. *Q.* In what tract?—In the Sutlej river.

153. *Q.* I think under the Punjab rules 20 years is the extreme limit of exemption from enhanced assessment on private improvements. Do you consider that sufficient?—I should say it was for the generality of cases. It depends on the cost of the well and the depth of the water.

154. *Q.* In exceptional cases is there power to lengthen the period?—I don't think so. I never came across a case of the kind.

155. *Q.* Supposing a man builds a well, what security is there that he gets his exemption?—The main security is that these are all revised at the time of assessment. A list of new wells is made out showing the date of construction and all particulars about it, and the fixed revenue is distributed.

156. *Q.* Does the system work successfully?—Yes.

157. *Q.* Is there not a similar exemption for tenants who have spent money?—Speaking of Montgomery, it is very rarely that tenants ever do spend money.

158. *Q.* With regard to the *takavi* rules in the Punjab, they only take security on the area to be cultivated?—Yes. There is no collateral security required.

159. *Q.* Has the security to be registered?—It is not formally registered. A memorandum is sent to the Registry Office and filed.

160. *Q.* He does not appear before the Registration Officer?—No.

161. *Q.* Is there any provision for accepting the joint personal security of the owners of a village?—Yes, that is done.

162. *Q.* There is a provision for it?—It is very seldom done. But there is provision for it.

163. *Q.* Is there in sinking wells any great likelihood of failure?—No; spring wells are rare, and the supply being mostly by percolation from the rivers and from the canals, there is not much likelihood of failure.

164. *Q.* What do you think of the scheme of Government undertaking actual construction of wells and recouping itself by a rate on the area irrigated?

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—I think that is a matter for consideration; the arrangement would be fairly popular.

165. *Q.* Why do you think this scheme would be popular?—I don't think the zamindar would think much about it. He would have his well. I doubt if Government would be prepared to take it on.

166. *Q.* Well-irrigation depends very much on the supply of bullocks; in these years of drought has the well irrigation been restricted owing to want of fodder for the bullocks and the dying of bullocks?—Yes, in the case of wells that are not assisted by canals; that is one advantage of canal irrigation; it enables fodder to be grown for bullocks in the *kharif* without well irrigation.

Colonel L. J. H. Grey

Colonel L. J. H. GREY, Superintendent, Bahawalpur State.

(*Lahore, 29th October 1901.*)

I.—Memorandum by Witness on Canals and Wells.

The subject on which I can give opinions are—

(1) Co-operative district canals.

(2) Inundation canals generally.

(3) Construction of wells.

2. As to (1), these may, in my opinion, be dismissed from consideration. There is only one such enterprise that I know of which has succeeded and is of any importance, and for many reasons none such is ever likely to succeed again, or indeed to be attempted.

3. The Ferozopore canals have worked successfully for many years, and they are important as having an irrigating capacity of considerably above 200,000 acres and having actually attained that area of irrigation. Their construction is fully described in printed reports of 1875-76-77, and my painful experiences therein stated would, I imagine, deter any District Officer from attempting to imitate the operation, even were it now possible to do so. I returned to Ferozepore in 1880 to find the irrigation system in danger of collapse, but succeeded then in renewing and extending it, and I devised the existing system of maintenance before I left the district in 1882, as described in a report of that year. In 1883-84, as Commissioner of the Hissar Division, I extended the system into Fazilka, completing it as it now exists; and in 1890, as Officiating Financial Commissioner, I remodelled the system of maintenance established in 1882, as detailed in the Government Proceedings of November 1890. I have fully stated the method of construction and maintenance of such works in a manual published by Government in 1881. Since then I have no further knowledge of them, but Rai Bahadur Maya Das, who has been in charge of the canals since 1882, can give any particulars that may be required.

4. With regard to (2) of my paragraph 1, my opinion is that the days of inundation irrigation have passed. The rivers have been, or are being, tapped to a degree which much lowers the value of these works by depriving them of the early and late water which is so important to irrigators. The method was after all, but a makeshift; it has had its day; and the time has come for arresting the summer floods by weirs, and for distributing them scientifically over the country to afford a duty of 200 acres to the cusec instead of the 30 or 40 acres which is the average of inundation canals.

On the special subject of inundation canals in the Bahawalpur State, Khan Bahadur Mirza Jind Vade Khan, the Wazir of the State, will give information better than I can.

5. As to (3) of my paragraph 1, my view is that well construction should go hand in hand with the canal irrigation which affords the springs for well irrigation. Canal water should be given so very sparingly as to drive the people to use the wells they have and to sink others. Not only would the water thus go much further, but we should hear less of water-logging and malaria. The ideal canal irrigation to my mind is that which creates and extends well irrigation, and is supplemented by the latter when river water fails.

Development of well irrigation, like any other form of district progress, depends upon the District Officer. That the District Officer should be able to achieve anything in this direction, he needs—

(*a*) knowledge of his villages;

(*b*) time for moving about and attending to his enterprise;

(*c*) a free hand in *takavi*.

(*a*) of the above implies some permanence of tenure, and of course both zeal and discretion are supposed.

As regards (*c*), in no commercial enterprise can anything be achieved unless risk is taken. It should be accepted that the Deputy Commissioner may occasionally lose money. But on the whole what better business can there be than one which borrows at 3½ per cent. to lend at 6¼, and which makes an average of Rs. 500 profit on every well constructed on these terms? I here assume that the wells will be charged from Rs. 15 to 25 *abiana*, say an average of Rs. 20 per annum, for the balance of an average well life of 40 years, after expiry of an average period of protection of 15 years:—20 × (40 — 15) = 500. In the Bahawalpur State *takavi* is given without charge of interest. I attach a memorandum which I there issued showing the commercial advantage, even on those terms, in encouraging well cultivation by liberal loans. The well's life is therein taken as permanent, because, in fact, timely outlay on repair does extend it to an indefinite period.

During the last two years there has been a great extension of well construction on *takavi* loans in Bahawalpur, regarding which the Wazir can give particulars. This, however, is likely to suffer, as the inundation canals there are already suffering from the effect of the great works constructed, under construction, or projected, in the Punjab.

Note by Colonel L. J. H. Grey addressed to the Mashir Mal regarding profit on takavi wells, dated 9th March 1900.

In continuation of my memos. of 21st February 1900, 26th February 1900, and 2nd March 1900, on the subject of *takavi* it is well to show the actual figures of profit on lending money for wells.

2 Rupees 300 invested in Government paper yields 3½ per cent., or in 12 years it is worth $300 (1 + \frac{3\frac{1}{2}}{100})^{1}$ = Rs. 453-5-0. (*a*)

If the Rs. 300 be lent on *takavi*, it is recovered in 12 years as follows:—

		Rs.	A.	P.
2 years		*Nil.*		
3rd year	$30 = 30 (1 + \frac{3\frac{1}{2}}{100})^{9}$ =	40	14	0
4th „	$30 = 30 (1 + \frac{3\frac{1}{2}}{100})^{8}$ =	39	8	0
5th „	$30 = 30 (1 + \frac{3\frac{1}{2}}{100})$ =	38	3	0
6th „	$30 = 80 (1 + \frac{3\frac{1}{2}}{100})$ =	36	14	0
7th „	$30 = 30 (1 + \frac{3\frac{1}{2}}{100})^{5}$ =	35	10	0
8th „	$30 = 30 (1 + \frac{3\frac{1}{2}}{100})^{4}$ =	34	7	0
9th „	$30 = 30 (1 + \frac{3\frac{1}{2}}{100})^{3}$ =	33	4	0
10th „	$30 = 37 (1 + \frac{3\frac{1}{2}}{100})^{2}$ =	32	2	0
11th „	$30 = 30 (1 + \frac{3\frac{1}{2}}{100})^{1}$ =	31	1	0
12th „	$30 = 30 (1 + \frac{3\frac{1}{2}}{100})^{0}$ =	30	0	0
	Total	351	15	0 (*b*)

(*a*) minus (*b*) or Rs. 101-6 is therefore the actual cost of the loan to the State.

3. For this capital outlay of Rs. 101-6 the State will obtain, for ever, charge imposed on the well after expiration of the 12 years' *Patta*, say 20 per cent. per annum, if my recommendation in paragraph 4 is adopted. There are indeed few investments which yield so large a return as 20 per cent.

4. I recommend that this charge be fixed at Rs. 20 *bilmukta* in excess of whatever the 50 *bighas* of land may be paying at the revenue rates of the village, *viz.*, Rs. 20 should be added to the *jama* of the village, and to the *Khatauni* of the well owner, after 12 years from date of completion of the well.

II.—Note upon the statements of Ferozepore irrigation furnished to the Irrigation Commission by Rai Bahadur Maya Das, dated the 16th October 1901.

(Not printed.)

Colonel L. J. H. Grey.

1. *Q.* (*The President.*)—You are Superintendent of the Bahawalpur State?—Yes.

2. *Q.* How long have you been there?—Two and a half years. I was there before as well.

3. *Q.* You have had a good deal of experience of the Punjab?—Yes.

4. *Q.* Have you had personally to deal with famine relief?—No.

5. *Q.* In your memorandum you mention co-operative canals. What are they?—Such as the people construct and manage themselves.

6. *Q.* Why do you say that they should be dismissed from consideration?—The circumstances for their construction were particularly favourable in Ferozepore, but they will never be made again.

7. *Q.* They were constructed about 25 years ago?—Yes. I saw no chance of anything being done, so I held meetings and invited people to join. The Lieutenant-Governor came over in the second year of construction and determined to see things for himself and the whole matter dropped, so I was in the position of having unfinished canals on my hands. However, I borrowed the money, and the thing was done.

8. *Q.* The system could not be generally applied?—No.

9. *Q.* Have you any faith in District Boards being able to work a canal?—In Ferozepore they do. On the 15th of January the headmen meet together and pass the accounts for the previous year and estimate the expenditure for the future; this they distribute over their irrigated lands by a rate which is now about three annas per acre. I don't think it can be done again.

10. *Q.* You are clear that District Boards could not do it?—Yes.

11. *Q.* You say in paragraph 4 of your note—"My opinion is that the days of inundation canals have passed, rivers are being tapped to a degree which lowers the value of these works by depriving them of the early and late waters." Will you kindly give some details?—We reckon that we also one foot of depth at the beginning of the floods and one foot at the end due to the perennial canals. Our statistics show that we lose this.

12. *Q.* You have got a system of gauges?—Yes, the whole thing has to be thoroughly worked out. It is a very important matter. We have gone as far as possible in meeting the loss by deepening and regrading.

13. *Q.* You say that a dam can arrest some of the floods for years?—We believe that.

(Colonel Grey then described from the map a scheme they had on hand for a canal above Rasul, but which was impossible without a weir. He said there was room for eight to ten lakhs of people.)

14. *Q.* Is the population thick?—The population of the Bahawalpur State is only a little over eight lakhs. There is room for as many more.

15. *Q.* Is there room for a colonisation scheme?—Yes, on a very large scale.

16. *Q.* Would the Durbar pay its share in the weir?—Yes. I am putting forward a scheme now.

17. *Q.* You know no places where water could be stored?—No. There is no place in Ferozepore or in any place I am acquainted with.

18. *Q.* Do you think people would be contented, having started with canal irrigation, to make wells to carry the crops to maturity?—I have always regretted to see the extent to which canal irrigation throws wells out of use as on the Jumna Canal. The natural tendency is of course to close wells and take the much easier flow.

19. *Q.* Do you think it practicable to compel the people to take to well irrigation?—I think it might be done if the canal water were given to the village for a limited area only. The surplus water could then be used to extend irrigation on the canals.

20. *Q.* Does that mean that the field could be irrigated partly by canals and partly by wells?—With the aid of canal, the well's irrigation of 20 acres would be doubled or trebled. According to my experience, whenever we give inundation canals, the people, on finding the canal water uncertain, sink wells. During the last two years applications have been put in for a little over 11 lakhs. In Bahawalpur we have already paid out Rs. 8,81,000. They find it profitable to have the wells, and I find this a most satisfactory investment of money.

21. *Q.* Are *takavi* advances given as in British territory?—Yes, but free of interest, and the period of recovery is 12 to 20 years.

22. *Q.* From your previous experience of districts under British rule, do you think *takavi* advances necessary?—Yes.

23. *Q.* In Bahawalpur is there a simple way of getting the money?—Yes, the administration wanted to hedge the system round with protective measures, but the people would not take the money till these were relaxed.

24. *Q.* You have seen mischief done by too much precaution?—Yes.

25. *Q.* I suppose in Bahawalpur the people are looking with considerable alarm on the proposal for the Lower Bari Doab Canal?—Of course, the people quite see that even with this canal, if we get a weir in the Sutlej, it will revolutionize the irrigation. (Witness described on the map where the weirs could be placed.)

26. *Q.* (*Mr. Higham.*) What are the facts in regard to the Bahawalpur canals running in the *rabi*? We have got four running now, which, I think, will run up to Christmas.

27. *Q.* Do they always run up to Christmas?—Yes.

28. *Q.* Do the same canals run?—Not necessarily.

29. *Q.* Are there always some canals running?—I have never known when we have not had one or two.

30. *Q.* In spite of the fact that the canals have been silted up?—Yes. Working in quicksand is a speciality of the people of Bahawalpur.

31. *Q.* You mean to say they clear the sand away much lower than the surface of water in the river?—Yes, two or three feet below zero.

32. *Q.* But you can't get water all through the cold weather; your canal is silted up?—They turn to and clear it out—have been doing this for a great number of years.

33. *Q.* They get it cleared out before February or March?—Yes.

34. *Q.* With regard to wells, is it not necessary to have wells to mature *rabi* crops?—It is very necessary. No man likes to put in *rabi* without a well. You might say it is a *sine quâ non*.

35. *Q.* If they flood the land in August or September, they require the assistance of the well later on?—Yes, I think so. With reference to a remark which fell from Mr. Merk, we supply borers and boring tools to well-sinkers free of expense; we find it well worth the cost.

36. *Q.* (*Mr. Ibbetson.*) Is the assistance largely made use of?—Yes.

37. *Q.* (*Mr. Wilson.*)—What does Government get from the development of the inundation canals in Ferozepore?—My information is rather stale. It was getting some years ago Rs. 67,000 a year.

38. *Q.* Owing to enhanced revenue?—Yes—'Water advantage rate.'

39. *Q.* Has Government advanced money or spent money in developing this system?—No.

40. *Q.* As Government gets more increased revenue, would it not be reasonable to expect it to improve the canals?—No; a condition which I made for the people was that they should have the canals free for a certain period only, *viz.*, till expiration of the settlement; this came to thirteen years.

41. *Q.* Do you think that the system by which the people themselves manage their canals and maintain them can be continued indefinitely?—Yes, if you can get the men; if you could get another Maya Das.

42. *Q.* If you could not, do you consider that Government should continue the management on the present footing or charge a water-rate?—I think the people would prefer doing it alone. The idea is

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that Maya Das should train a man. That was my idea. He has a man in training in whom he has great faith. I think it would be worth trying.

43. *Q.* If he does not succeed?—I think the people would prefer being left alone.

44. *Q.* Suppose Government did charge water-rates, what rates should they charge?—The cost of maintenance Re. 0-11-6 per acre irrigated, *plus* the present charge of 12 annas per acre water advantage rate. I would not put on more, as Government spent nothing on the work.

45. *Q.* You said you don't think a similar system of canals could be attempted anywhere else?—I don't think it could.

46. *Q.* Would you encourage private owners to make canals of their own elsewhere?—Yes. I don't see any objection.

47. *Q.* Would it be better in future to encourage private owners to make canals or for Government to make them?—My view is that on inundation canals water is largely wasted. The water should be applied to the best purpose only. I am not in favour of inundation canals except so far as an *ad interim* arrangement. Proper scientific principles should be introduced.

48. *Q.* Is there a large area that can be irrigated from the weir which you propose?—Speaking of Bahawalpur, a couple of falls would supply the water to the existing canals in the valley. We will have to feed those canals from the *one* single head. I believe also that a great mass of the water percolates back from the irrigated land into the river. Some Engineers say that it all comes back. Anyway, I should imagine that this water percolating back into the river will supply means for well cultivation in the valleys. If you have water within 30 feet, it is as good as any man could wish.

49. *Q.* If you feed an inundation canal from a perennial canal, is there no danger?—I don't see that if you drop the water by falls.

50. *Q.* But why should not the valley canals continue to work; there will always be surplus water in the river?—Doubtless there is always that with a weir. A portion of the supply will pass on and can be utilized if they sink beds low enough.

51. *Q.* If the water of the Sutlej were taken out on the left bank, is there sufficient land commandable to utilize it all?—I think there is in two-thirds of the Bahawalpur State territories where it is level as a billiard table except for occasional sand-hills.

52. *Q.* That would be commanded by a canal?—Yes.

53. *Q.* If these weirs were made, Bahawalpur would be prepared to pay a portion of the cost?—As represented by me, yes. I think, too, the Nawab is fully persuaded of the benefit that would be derived.

54. *Q.* Is there a sufficient sum likely to become available to spend on large weirs of this description?—I think we could have 40 lakhs of rupees ready in eight years' time. The question won't arise before then.

55. *Q.* Where would the colonists come from?—They would pour in from Ferozepore and Patiala.

56. *Q.* You have already British subjects there?—Yes, as far as this canal extends, it is entirely populated by Ferozepore Jats. I got them in 1871-73. They settled on the condition that this canal would be made. The land is now pretty well irrigated. They will not ordinarily settle in the valley. In recent years immigration has been checked by the late Nawab's sporting proclivities; a Jat does not care about being dragged out for three or four days for driving game.

57. *Q.* And, generally speaking, there is no difficulty in attracting men from British territory?—No difficulty.

58. *Q.* I understand you advanced about nine lakhs of rupees *takavi*?—We advanced Rs. 8,84,369, which have been given out without interest. All this has been done in the last two years, 1900-01.

59. *Q.* In time, according to your plan, no loss will be incurred as regards payment?—I don't see how loss can be incurred if the well is made. The money is advanced by degrees. The money is put into the soil, and there is the man's holding.

60. *Q.* You advance the money without interest chiefly owing to prejudice against interest? Yes, for no other reason.

61. *Q.* You made a calculation as to what loss would be incurred by the State through not taking interest?—My calculation is attached to my memorandum. I make out that the State gains 20 per cent. even without taking interest.

62. *Q.* And the State gets, on the expiry of the period of exemption, twenty rupees a year?—An average of twenty rupees a year.

63. *Q.* In the case of boring tools, are they only used in finding the stratum of water or do they assist in the actual excavation of the well?—No. They only have a diameter of two to three inches. They are screwed in, and if they bring up bitter water or meet *hán* (hard pan), the place is abandoned.

64. *Q.* The *hán* you speak about in your memorandum is often six or eight feet thick. Is it ever broken through to see what is below?—I don't know. I see scores of wells abandoned.

65. *Q.* But would not this *hán* be an excellent foundation for the well?—No. It is too near the surface.

66. *Q.* My idea is to break through the *hán*; would it not be a great assistance; is it not worth trying? Would it not give sufficient water from below?—I daresay. Heenan at great cost and immense difficulty broke through two or three to get pure water. Without that we were plagued with scurvy owing to the salts in the shallow wells.

67. *Q.* (*Mr. Ibbetson.*)—Why do you think District Board will not manage canals?—The composition of the Board. The Board that manages the canals should be composed of men who are vitally concerned.

68. *Q.* You have no hope of management by District Boards?—No.

69. *Q.* One result of a canal being taken over by Government would be that the co-operative labour system would be abandoned and a rate would be charged to cover the cost. That would be very unacceptable to the people?—No, I am not sure that it would. I think they would prefer to pay the value in Ferozepore, but whether it would finally suit them, I don't know. At present any one who does not wish to work pays the value of the cubic contents of his share of clearance, and a contractor is always willing to take it over.

70. *Q.* It would be a disadvantage on the whole to give up Statute labour?—Yes, I think so.

71. *Q.* You are very strong on the point that canal irrigation should supplement well irrigation and not supersede it?—Yes. It is the well that supplements the canal; the *rabi* cannot be trusted to the canal.

72. *Q.* Are you referring to inundation canals only?—Yes, I am not contemplating the great canals that take off from the foot of the Himalayas.

73. *Q.* You are referring to wells of which the depth of water would not be variable?—Yes; but all canal-fed wells sink slightly when the canal is dry.

74. *Q.* You don't wish it to be applied to the Sirhind and Jumna Canals?—Hardly that; I think the restriction of canal water and the use of wells to supplement canal irrigation is universally desirable, though on perennial canals the *rabi* is not actually dependent upon wells.

75. *Q.* You do wish to include the Western Jumna Canal?—I include the whole.

76. *Q.* With reference to what you say in paragraph 5 about well irrigation being supplemented—take the case of a canal of which the flow is continuous. As has just been pointed out, in order to avoid the canal superseding wells, you would have two distinct areas—a canal area and a well area?—No; that has been pointed out, but I do not agree—I think it perfectly possible to limit the number of canal waterings and leave wells to do the rest.

77. *Q.* Is it not a fact that on the introduction of a canal the whole agricultural economy changes—for instance, big cattle are required to work wells. Would not that create a difficulty?—Yes; as regards the fact, not as regards the difficulty. The canal necessarily itself raises water level and renders the well easier to work.

78. *Q.* You don't think that difficulty will arise?—No.

79. *Q.* Though you think the days of inundation irrigations are passed, you would still utilize flood water by inundation canals?—Certainly, till it could be better utilized by scientific canals from weirs. In the construction of inundation canals the money is less well applied, it is better used up on arrangements which will give two hundred acres to the cusec.

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80. *Q*. You propose to take away the whole supply of the Sutlej at the beginning and end of the season and utilize it higher up?—Yes. Of course, that is below Fazilka.

81. *Q*. How about the people in the valley? No money can compensate them for the loss?—We have talked that over in Bahawalpur, and agree that they will be perfectly compensated by being given sufficient land on this new canal and money to build, while at the same time feeding the existing valley canals as far as possible.

82. *Q*. You would move them up?—Yes. Of course, it would be a complete revolution.

83. *Q*. Have you been able to make improvements in the *takavi* procedure?—I think I have succeeded in making considerable improvements in Bahawalpur. We want no inquiry by the Revenue officials.

84. *Q*. How do you manage to dispense with the Patwari and Kanungo?—We take the particulars of the man's holding out of the settlement file and accept the last entry recorded in the annual papers. I had great difficulty in obtaining this exemption, but I proved the advantage to the Durbar on the evidence of the men who paid large proportions of *takavi* grants to the Tahsil officials, and the Durbar agreed to accept extracts of the revenue records, and that the money should be paid on the spot by the Kardars themselves.

85. *Q*. A suggestion has been made that Government should make wells in private lands. Do you think the scheme would work?—I cannot imagine it. If a man wanted the improvement, he would make it himself if *takavi* were rendered easy. I don't think he would care about a State encumbrance on his land. The land would not be his own any more.

MR. R. SYKES, Director of Land Records, Punjab.

(*Lahore, 29th October 1901.*)

Mr. R. Sykes.

STATEMENT I.—Showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900.

DISTRICT AND YEAR.		NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation, column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN	
		Pakka, column 16 of Statement III.	*Kachcha*, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Hissar	1889-90	664	149	813	2,860	..	...
	1890-91	629	90	719	3,020	...	...
	1891-92	586	44	630	1,965	3	...
	1892-93	561	31	592	1,073	...	...
	1893-94	548	28	576	1,306	...	...
	1894-95	547	35	582	1,298	...	...
	1895-96	613	117	730	5,108	...	...
	1896-97	823	359	1,182	9,105	...	...
	1897-98	826	241	1,067	3,402	..	...
	1898-99	847	352	1,199	7,160	...	...
	1899-1900	993	434	1,427	8,980	...	6
	Increase or decrease as compared with 1889-90.	+ 329	+ 285	+ 614	+ 6,120	...	...
Rohtak	1889-90	1,702	462	2,164	21,834	...	...
	1890-91	1,843	540	2,383	26,438	...	...
	1891-92	1,834	510	2,344	24,673	11	...
	1892-93	2,040	75	2,115	19,672	...	...
	1893-94	2,082	358	2,440	18,267	...	...
	1894-95	2,130	416	2,546	14,593	...	...
	1895-96	2,177	551	2,728	23,067	...	...
	1896-97	2,521	2,644	5,165	35,435	...	...
	1897-98	2,555	775	3,330	24,713	...	...
	1898-99	2,626	2,001	4,627	30,376	...	...
	1899-1900	2,770	3,597	6,367	31,030	...	5
	Increase or decrease as compared with 1889-90.	+ 1,068	+ 3,135	+ 4,203	+ 9,196	...	...
Gurgaon	1889-90	7,980	2,188	10,168	78,734	...	...
	1890-91	8,037	2,293	10,330	87,304	...	...
	1891-92	8,135	2,212	10,347	82,695	8	...
	1892-93	5,270	2,230	7,500	74,280	...	...
	1893-94	8,216	2,118	10,334	77,468	...	...
	1894-95	8,241	1,889	10,130	60,279	...	...
	1895-96	8,391	3,048	11,439	83,241	...	...
	1896-97	8,555	3,519	12,074	105,019	...	...
	1897-98	8,636	2,675	11,311	83,103	...	...
	1898-99	8,782	4,042	12,824	101,531	...	...
	1899-1900	9,189	7,918	17,107	113,019	...	7
	Increase or decrease as compared with 1889-90.	+ 1,209	+ 5,730	+ 6,939	+ 34,285	...	...

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STATEMENT I.—Showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—*continued.*

District and year.		Number of wells in use.			Area of crops matured by well irrigation, column 7 of Statement III.	Average area of crops matured per well in	
		Pakka, column 16 of Statement III.	*Kachcha,* column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Delhi	1889-90	6,487	840	7,327	75,940	...	...
	1890-91	6,563	813	7,376	77,415	...	...
	1891-92	8,039	619	8,658	61,969	7	...
	1892-93	5,498	492	5,990	51,062	...	...
	1893-94	8,248	523	8,771	53,877	...	...
	1894-95	8,252	462	8,714	19,031	...	...
	1895-96	8,391	639	9,030	69,394	...	...
	1896-97	8,804	1,702	10,506	110,287	...	...
	1897-98	8,955	877	9,832	80,425	...	...
	1898-99	9,213	1,034	10,247	107,071	...	...
	1899-1900	9,546	3,235	12,781	121,257	...	10
	Increase or decrease as compared with 1889-90.	+ 3,059	+ 2,395	+ 5,454	+ 45,317	...	...
Karnal	1889-90	7,916	439	8,355	108,938	...	...
	1890-91	7,827	353	8,180	90,786	...	...
	1891-92	8,604	365	8,969	85,080	9	...
	1892-93	7,411	107	7,608	74,411	...	...
	1893-94	9,259	154	9,413	74,728	...	...
	1894-95	9,372	146	9,518	26,515	...	...
	1895-96	9,518	210	9,728	93,808	...	...
	1896-97	9,922	400	10,322	133,579	...	...
	1897-98	10,003	281	10,284	104,458	...	...
	1898-99	10,244	317	10,561	125,129	...	...
	1899-1900	10,775	784	11,559	158,662	...	14
	Increase or decrease as compared with 1889-90.	+ 2,859	+ 345	+ 3,204	+ 49,724	...	...
Umballa	1889-90	2,101	2,405	4,506	26,976	...	...
	1890-91	2,024	2,072	4,096	20,607	...	...
	1891-92	2,143	1,644	3,787	21,446	6	...
	1892-93	2,228	1,507	3,735	16,568	...	...
	1893-94	2,304	1,532	3,836	19,214	...	...
	1894-95	2,374	1,383	3,757	7,431	...	...
	1895-96	2,443	2,107	4,550	19,036	...	...
	1896-97	2,726	4,967	7,693	40,255	...	...
	1897-98	2,745	2,644	5,389	25,626	...	...
	1898-99	2,784	2,417	5,201	28,107	...	...
	1899-1900	3,229	13,699	16,928	61,489	...	4
	Increase or decrease as compared with 1889-90.	+ 1,128	+ 11,294	+ 12,422	+ 34,513	...	...
Kangra	1889-90	...	44	44	17	..	...
	1890-91	...	35	35	26	...	...
	1891-92	...	...	...	23	...	...
	1892-93	...	...	...	...	...	...
	1893-94	...	...	...	...	...	...
	1894-95	...	...	...	...	...	...
	1895-96	4	44	48	...	..	...
	1896-97	4	49	53	...	...	...
	1897-98	4	51	55	..	...	...
	1898-99	4	51	55	...	...	...
	1899-1900	4	78	82	...	...	...
	Increase or decrease as compared with 1889-90.	+ 4	+ 34	+ 38	− 17	...	...

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STATEMENT I.—Showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—*continued*

District and year.		Number of wells in use.			Area of crops matured by well irrigation, column 7 of Statement VIII.	Average area of crops matured per well in	
		Pakka, column 16 of Statement III.	*Kachcha*, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899 1900.
Hoshiarpur	1889-90	3,628	7,360	10,988	41,679	...	...
	1890-91	3,662	6,733	10,395	35,896	...	...
	1891-92	3,877	7,363	11,240	37,347	3	...
	1892-93	4,045	6,803	10,848	22,003	...	...
	1893-94	4,116	5,190	9,306	22,182	...	...
	1894-95	4,776	5,472	10,248	14,196	...	...
	1895-96	4,919	6,433	11,352	39,417	...	...
	1896-97	5,077	9,991	15,068	50,787	...	...
	1897-98	5,237	8,078	13,315	41,860	...	...
	1898-99	5,402	8,096	13,498	44,985	...	...
	1899-1900	5,691	15,412	21,103	83,427	...	...
	Increase or decrease as compared with 1889-90.	+ 2,063	+ 8,052	+ 10,115	+ 41,748	...	...
Jullundur	1889-90	22,715	627	23,342	364,237	...	...
	1890-91	23,163	715	23,878	346,974	...	...
	1891-92	23,788	575	24,363	348,601	14	...
	1892-93	24,541	612	25,153	326,858	...	...
	1893-94	24,703	512	25,215	326,171	...	...
	1894-95	24,915	433	25,348	280,826	...	...
	1895-96	25,107	472	25,579	375,009	...	...
	1896-97	25,487	689	26,176	397,221	...	...
	1897-98	26,010	574	26,584	392,387	...	...
	1898-99	26,350	580	26,930	388,316	...	...
	1899-1900	26,897	1,419	28,316	410,626	...	15
	Increase or decrease as compared with 1889-90.	+ 4,182	+ 792	+ 4,974	+ 46,389	...	...
Ludhiana	1889-90	8,288	553	8,841	166,645	...	...
	1890-91	8,448	547	8,995	162,138	...	...
	1891-92	8,539	470	9,009	161,665	18	...
	1892-93	8,938	498	9,436	123,120	...	...
	1893-94	9,058	487	9,545	158,284	...	...
	1894-95	9,136	485	9,621	109,261	...	...
	1895-96	9,201	515	9,716	165,851	...	...
	1896-97	9,293	538	9,831	183,512	...	...
	1897-98	9,399	547	9,946	174,415	...	...
	1898-99	9,672	597	10,269	180,190	...	...
	1899-1900	9,924	1,536	11,460	200,273	...	17
	Increase or decrease as compared with 1889-90.	+ 1,636	+ 983	+ 2,619	+ 33,628	...	...
Ferozepore	1889-90	5,275	668	5,943	110,583	...	...
	1890-91	5,631	570	6,201	123,414	...	...
	1891-92	5,895	577	6,472	130,054	20	...
	1892-93	5,951	503	6,454	85,938	...	...
	1893-94	6,313	406	6,719	97,184	...	...
	1894-95	5,452	257	5,709	95,220	...	...
	1895-96	6,683	386	7,069	139,959	...	...
	1896-97	7,118	687	7,805	152,792	...	...
	1897-98	7,416	675	8,091	146,906	...	...
	1898-99	7,631	697	8,328	149,574	...	...
	1899-1900	8,066	1,252	9,318	188,570	...	20
	Increase or decrease as compared with 1889-90.	+ 2,791	+ 584	+ 3,375	+ 77,987	...	...

Mr. R. Sykes.

STATEMENT I.—Showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—*continued.*

District and year.		Number of wells in use.			Area of crops matured by well irrigation, column 7 of Statement VIII.	Average area of crops matured per well in	
		Pakka, column 16 of Statement III.	*Kachcha,* column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Mooltan	1889-90	15,351	4,925	20,276	120,387	...	...
	1890-91	15,161	4,783	19,944	124,226	...	...
	1891-92	17,800	4,664	22,464	105,314	5	...
	1892-93	18,288	4,723	23,011	104,943	...	...
	1893-94	18,493	4,496	22,991	102,015	...	...
	1894-95	18,640	3,914	22,554	110,538	...	...
	1895-96	18,853	3,901	22,754	130,731	...	...
	1896-97	19,210	3,772	22,982	138,678	...	...
	1897-98	19,470	3,879	23,349	107,920	...	...
	1898-99	19,721	3,870	23,591	123,638	...	...
	1899-1900	19,950	4,194	24,144	181,361	..	8
	Increase or decrease as compared with 1889-90.	+ 4,599	– 731	+ 3,868	+ 60,974	...	...
Jhang	1889-90	13,433	229	13,662	272,003	...	...
	1890-91	13,677	175	13,852	290,257	...	...
	1891-92	14,721	166	14,887	271,559	18	...
	1892-93	15,550	189	15,739	282,638	...	...
	1893-94	15,819	134	15,953	287,440	...	...
	1894-95	15,922	107	16,029	266,064	...	...
	1895-96	15,912	191	16,103	266,594	...	...
	1896-97	15,940	288	16,228	256,024	...	...
	1897-98	15,971	372	16,343	269,846	...	...
	1898-99	16,115	284	16,399	242,519	...	...
	1899-1900	16,235	452	16,687	195,553	...	12
	Increase or decrease as compared with 1889-90.	+ 2,802	+ 223	+ 3,025	– 77,450	...	...
Montgomery	1889-90	8,777	1,420	10,197	179,819	...	...
	1890-91	9,242	1,063	10,305	209,799	...	...
	1891-92	10,056	1,241	11,297	169,302	15	...
	1892-93	9,591	1,221	10,812	162,117	...	...
	1893-94	10,255	957	11,212	163,918	...	...
	1894-95	10,438	978	11,416	149,585	...	...
	1895-96	10,379	1,170	11,549	170,673	...	...
	1896-97	10,868	1,376	12,244	169,186	...	...
	1897-98	10,822	1,618	12,440	164,079	...	...
	1898-99	11,140	1,404	12,544	213,383	...	...
	1899-1900	11,156	1,502	12,658	177,533	...	14
	Increase or decrease as compared with 1889-90	+ 2,379	+ 82	+ 2,461	– 2,286	...	...
Lahore	1889-90	12,686	2,080	14,766	314,544	...	...
	1890-91	12,843	1,738	14,581	327,396	...	..
	1891-92	13,183	2,140	15,323	279,868	18	...
	1892-93	13,338	2,040	15,378	284,179	...	...
	1893-94	13,290	2,268	15,558	284,452	...	...
	1894-95	13,390	2,040	15,436	278,647	...	...
	1895-96	13,746	1,890	15,636	282,708	...	...
	1896-97	14,011	2,143	16,154	272,532	...	...
	1897-98	14,182	2,368	16,450	308,638	...	...
	1898-99	14,447	2,532	16,979	296,236	...	...
	1899-1900	14,937	2,341	17,278	271,707	...	16
	Increase or decrease as compared with 1889-90.	+ 2,251	+ 261	+ 2,512	– 42,837	...	...

Mr. B. Sykes.

STATEMENT I.—Showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—*continued.*

District and year.		Number of wells in use.			Area of crops matured by well irrigation, column 7 of Statement VIII.	Average area of crops matured per well in	
		Pakka, column 16 of Statement III.	*Kachcha,* column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Amritsar	1889-90	10,112	415	10,527	289,206	...	...
	1890-91	10,225	610	10,835	255,742	...	...
	1891-92	10,467	441	10,908	266,382	24	...
	1892-93	10,558	351	10,909	194,851	...	...
	1893-94	10,627	370	10,997	208,272	...	...
	1894-95	10,190	382	10,572	159,616	...	...
	1895-96	10,952	398	11,350	266,455	...	...
	1896-97	11,118	435	11,553	292,680	..	..
	1897-98	11,267	418	11,685	276,173	...	..
	1898-99	11,407	394	11,801	277,368	...	..
	1899-1900	11,731	413	12,144	308,111	...	25
	Increase or decrease as compared with 1889-90.	+ 1,619	— 2	+ 1,617	+ 18,905	...	...
Gurdaspore	1889-90	5,417	3,229	8,646	139,912	...	...
	1890-91	5,447	2,850	8,297	113,237	...	...
	1891-92	5,556	3,028	8,584	128,637	15	...
	1892-93	5,489	3,077	8,566	77,228	...	...
	1893-94	5,599	2,858	8,457	86,599	...	...
	1894-95	5,627	2,664	8,291	59,746	...	...
	1895-96	5,704	2,715	8,419	120,172	...	...
	1896-97	5,868	3,378	9,246	141,435	..	...
	1897-98	5,947	3,333	9,280	136,703	...	...
	1898-99	6,151	3,547	9,698	121,590	...	...
	1899-1900	6,922	4,004	10,926	168,580	...	15
	Increase or decrease as compared with 1889-90.	+ 1,505	+ 775	+ 2,280	+ 28,668	...	...
Sialkot	1889-90	19,110	2,028	21,138	504,471	...	...
	1890-91	19,348	1,943	21,291	423,472	...	...
	1891-92	20,265	1,960	22,215	464,674	21	...
	1892-93	20,633	1,790	22,425	414,125	..	...
	1893-94	20,853	1,623	22,076	384,244	...	...
	1894-95	20,856	1,536	22,492	356,273	...	...
	1895-96	20,945	1,520	22,465	434,033	...	...
	1896-97	21,313	1,621	22,934	478,664	..	...
	1897-98	21,803	1,657	23,460	518,895	...	...
	1898-99	22.213	1,836	24,049	459,004	...	...
	1899-1900	23,133	1,973	25,106	475,137	...	19
	Increase or decrease as compared with 1889-90.	+ 3,723	— 55	+ 3,668	+ 29,334	...	...
Gujrat	1889-90	8,640	562	9,202	211,831	...	...
	1890-91	8,475	351	8,826	158,156	...	...
	1891-92	8,697	309	9,006	182,327	20	...
	1892-93	8,735	280	9,015	209,117	...	...
	1893-94	8,719	241	8,960	173,786	...	...
	1894-95	8,750	338	9,088	175,207	...	...
	1895-96	8,783	524	9,307	182,420	...	...
	1896-97	9,007	506	9,513	184,128	...	...
	1897-98	9,187	609	9,796	208,342	...	...
	1898-99	9,297	617	9,914	189,469	...	...
	1899-1900	9,897	1,082	10,979	193,490	...	18
	Increase or decrease as compared with 1889-90.	+ 1,257	+ 520	+ 1,777	— 18,341	...	...

Mr. R. Sykes.

STATEMENT I.—Showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—*continued.*

District and year.		Number of wells in use.			Area of crops matured by well irrigation, column 7 of Statement VIII.	Average area of crops matured per well in	
		Pakka, column 16 of Statement III.	*Kachcha*, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Gujranwala	1889-90	12,149	115	12,264	396,730	...	...
	1890-91	12,127	136	12,263	383,290	...	...
	1891-92	12,239	113	12,352	342,815	28	...
	1892-93	12,304	157	12,461	358,336	...	...
	1893-94	12,248	92	12,340	357,946	...	..
	1894-95	12,226	132	12,358	358,034	...	...
	1895-96	12,248	144	12,392	330,671	...	...
	1896-97	12,286	137	12,423	326,438	...	...
	1897-98	12,383	225	12,608	359,206	...	...
	1898-99	12,475	223	12,698	343,478	...	...
	1899-1900	12,548	269	12,817	287,624	...	22.
	Increase or decrease as compared with 1889-90.	+ 399	+ 154	+ 553	— 109,116	...	...
Shahpur	1889-90	6,534	357	6,891	171,159	...	
	1890-91	6,601	312	6,913	186,679	...	...
	1891-92	6,674	273	6,947	150,848	22	...
	1892-93	6,668	197	6,865	172,086	...	...
	1893-94	6,709	144	6,853	174,430	...	...
	1894-95	6,810	116	6,926	172,847	...	...
	1895-96	6,973	156	7,129	165,209	...	...
	1896-97	7,133	198	7,331	158,417	...	...
	1897-98	7,257	180	7,437	177,720	...	...
	1898-99	7,382	212	7,594	160,512	..	...
	1899-1900	7,489	279	7,768	145,849	...	19
	Increase or decrease as compared with 1889-90.	+ 955	— 78	+ 877	— 25,310	...	...
Jhelum	1889-90	4,520	401	4,921	39,332	...	...
	1890-91	4,615	420	5,035	36,875	...	...
	1891-92	4,599	444	5,043	39,172	8	...
	1892-93	4,576	360	4,936	40,393	...	...
	1893-94	4,561	297	4,858	36,748	...	...
	1894-95	4,532	210	4,742	37,958	...	...
	1895-96	4,577	311	4,888	36,469	..	...
	1896-97	4,626	326	4,952	37,428	...	...
	1897-98	4,616	311	4,927	36,457	...	...
	1898-99	4,633	293	4,926	36,787	...	...
	1899-1900	4,740	383	5,123	37,772	...	7
	Increase or decrease as compared with 1889-90.	+ 220	— 18	+ 202	— 1,560	...	...
Rawalpindi	1889-90	5,416	926	6,342	30,866	...	...
	1890-91	5,445	970	6,415	37,806	...	...
	1891-92	5,484	972	6,456	39,371	6	...
	1892-93	5,530	845	6,375	40,634	...	...
	1893-94	5,650	825	6,475	39,887	...	...
	1894-95	5,708	825	6,533	39,411	...	...
	1895-96	5,791	800	6,591	39,860	...	...
	1896-97	5,910	829	6,739	43,068	...	...
	1897-98	6,081	974	7,055	46,094	...	...
	1898-99	6,169	866	7,035	44,684	...	...
	1899-1900	6,293	896	7,189	45,043	...	
	Increase or decrease as compared with 1889-90.	+ 877	— 30	+ 847	+ 6,177	...	...

STATEMENT 1.—Showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—*continued.*

DISTRICT AND YEAR.		NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation, column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN	
		Pakka, column 16 of Statement III.	*Kachcha*, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Hazara	1889-90	219	45	264	1,256	...	...
	1890-91	220	61	281	1,124	...	...
	1891-92	218	52	270	1,181	4	...
	1892-93	214	66	280	1,317	...	...
	1893-94	202	65	267	1,268	...	...
	1894-65	217	64	281	1,325	...	..
	1895-96	219	70	289	1,368	...	...
	1896-97	225	72	297	1,589	...	...
	1897-98	232	70	302	1,599	...	...
	1898-99	238	77	315	1,558	...	...
	1899-1900	252	78	330	1,670	...	5
	Increase or decrease as compared with 1889-90.	+ 33	+ 33	+ 66	+ 414	...	...
Peshawar	1889-90	4,851	5,179	10,030	82,595	...	...
	1890-91	4,935	5,241	10,176	81,526	...	...
	1891-92	4,991	5,078	10,069	81,672	8	...
	1892-93	5,564	5,152	10,716	79,021	...	...
	1893-94	5,750	4,823	10,573	80,849	...	...
	1894-95	9,946*	912	10,858	75,081	...	...
	1895-96	9,916	958	10,874	71,713	...	...
	1896-97	10,065	955	11,020	73,718	...	...
	1897-98	10,198	950	11,148	77,050	...	...
	1898-99	9,969	1,000	10,960	77,043	...	...
	1899-1900	10,235	1,101	11,336	76,573	...	7
	Increase or decrease as compared with 1889-90.	+ 5,384	— 4,078	+ 1,306	— 6,022	...	...
Kohat	1889-90	359	205	564	1,873	...	...
	1890-91	367	202	569	1,877	...	...
	1891-92	381	193	574	1,874	3	...
	1892-93	388	192	580	1,936	...	...
	1893-94	361	216	577	2,307	...	...
	1894-95	359	208	567	2,003	...	...
	1895-96	329	197	526	1,752	...	...
	1896-97	341	195	536	1,842	...	...
	1897-98	369	172	541	1,888	...	...
	1898-99	381	178	559	1,719	...	...
	1899-1900	386	163	549	1,860	..	3
	Increase or decrease as compared with 1889-90.	+ 27	— 42	— 15	— 13	...	...
Bannu	1889-90	528	37	575	3,228	...	...
	1890-91	466	34	500	3,153	...	...
	1891-92	441	29	470	3,632	8	...
	1892-93	450	18	468	3,423	...	...
	1893-94	442	20	462	3,640	...	...
	1894-95	441	17	458	3,498	...	...
	1895-96	477	16	493	3,613	...	...
	1896-97	491	14	505	3,828	...	...
	1897-98	470	15	494	3,806	...	...
	1898-99	490	19	509	3,729	...	...
	1899-1900	541	26	567	4,452	...	8
	Increase or decrease as compared with 1889-90.	+ 3	— 11	— 8	+ 1,224	...	...

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* Increase in wells due to corrections made at settlement, chiefly in classification of *pakka* and *kachcha* wells.

Mr. R. Sykes.

STATEMENT I.—Showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—*concluded.*

District and year.		Number of wells in use.			Area of crops matured by well irrigation, column 7 of Statement VIII.	Average area of crops matured per well in	
		Pakka, column 16 of Statement III.	*Kachha,* column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Dera Ismail Khan	1889-90	5,325	841	6,166	92,824	...	...
	1890-91	5,358	884	6,242	102,201	...	...
	1891-92	5,189	892	6,381	107,038	17	...
	1892-93	5,759	810	6,560	104,461	...	...
	1893-94	5,891	805	6,696	101,558	...	...
	1894-95	6,002	744	6,746	103,007	...	...
	1895-96	6,206	824	7,030	108,937	...	...
	1896-97	6,331	833	7,164	110,128	...	...
	1897-98	6,416	799	7,215	108,926	...	...
	1898-99	6,686	790	7,476	107,001	...	...
	1899-1900	6,908	857	7,765	111,141	...	14
	Increase or decrease as compared with 1889-90.	+ 1,583	+ 16	+ 1,599	+ 18,320	...	...
Dera Ghazi Khan	1889-90	7,204	1,622	8,826	48,574	...	...
	1890-91	7,431	1,817	9,248	52,022	...	...
	1891-92	8,320	1,509	9,829	49,391	5	...
	1892-93	8,763	1,595	10,358	50,871	...	...
	1893-94	8,797	1,475	10,272	56,934	...	...
	1894-95	8,696	1,495	10,191	42,270	...	...
	1895-96	9,097	1,857	10,954	50,961	...	...
	1896-97	9,076	2,059	11,135	49,005	...	...
	1897-98	9,153	1,844	10,997	41,472	...	...
	1898-99	9,293	1,825	11,118	49,102	...	...
	1899-1900	9,390	2,071	11,461	47,297	...	4
	Increase or decrease as compared with 1889-90.	+ 2,186	+ 419	+ 2,635	— 1,277	...	...
Muzaffargarh	1889-90	12,243	2,309	14,552	52,373	...	...
	1890-91	12,407	2,365	14,772	59,467	...	...
	1891-92	13,501	2,371	15,872	52,308	3	..
	1892-93	13,885	2,145	16,030	52,107	...	...
	1893-94	14,259	1,744	16,003	54,608	...	...
	1894-95	14,434	1,818	16,252	52,460	...	...
	1895-96	14,583	1,949	16,532	52,260	...	...
	1896-97	14,683	2,035	16,718	50,004	...	...
	1897-98	14,739	2,076	16,815	48,409	...	...
	1898-99	14,757	2,206	16,963	45,583	...	...
	1899-1900	15,024	2,411	17,435	46,509	...	3
	Increase or decrease as compared with 1889-90.	+ 2,781	+ 102	+ 2,883	— 5,864	...	...
Grand Total of the Punjab.	1889-90	219,940	42,660	262,600	3,959,427	...	...
	1890-91	222,217	40,716	262,933	3,822,323	...	...
	1891-92	232,644	40,254	272,898	3,695,883	14	...
	1892-93	232,768	38,156	270,924	3,428,768	...	...
	1893-94	243,377	35,561	278,338	3,449,672	...	...
	1894-95	248,385	29,478	277,863	3,072,220	...	...
	1895-96	253,137	34,143	287,280	3,780,789	...	...
	1896-97	258,852	46,697	305,549	4,006,984	...	...
	1897-98	262,358	39,288	301,646	3,970,518	...	...
	1898-99	266,519	42,357	308,876	3,956,902	...	...
	1899-1900	274,851	73,859	348,710	4,154,598	...	12
	Increase or decrease as compared with 1889-90.	+ 54,911	+ 31,199	+ 80,110	+ 195,171	...	...

STATEMENT II.—Showing total area irrigated by wells, etc., and the average area irrigated per well from 1890-91 to 1899-1900.

(Not printed.)

Mr. R. Sykes.

1. *Q.* (*The President.*)—You are Director of Land Revenue and Agriculture and all the statistics pass through your hands?—All statistics except those relating to collection of revenue and the distribution of *takavi*.

2. *Q.* So in the course of our wanderings if we want statistics on any subject we should refer to you?—I shall be able to give them. The first statement attached to my memo. shows the number of wells and the average area of crops matured with the aid of well irrigation, both *pakka* and *kachcha*. It is based on crop returns of *chahi* crops, irrespective of the permanent classification of soil areas. The figures shown in this statement also include figures of double cropping. The second statement is headed "Statement showing the total area irrigated by wells, etc., and the average area irrigated per well from 1890-91 to 1899-1900." This statement is based on the returns regarding land permanently classified as well land; and the figures actually shown give the soil area out of such permanent well area, on which matured crops were actually grown in each year, whether actually well irrigated or not in a particular harvest, and without taking double cropping into account.

The soil classification of land, roughly speaking, is revised quadrennially. It is intended to show the permanent conditions under which agriculture is carried on. And as *kachcha* wells are generally only of a temporary character, the statistics in this return cannot be relied on to take account of *kachcha* well irrigation. On the whole, therefore, I venture to think that the first statement will be found to be of more value than this one.

The third statement is headed "Area of crops harvested per 1,000 of population." The population was taken from the returns of rural population at the recent census.

The fourth statement shows the number of masonry wells newly made and the number fallen in and disused during the last ten years. The first statement showing the area of crops harvested (including *do-fasli*) will give information which is more useful. The last statement shows the number of new wells made and the number fallen in and disused during the past ten years.

3. *Q.* (*Mr. Wilson.*)—Will you explain, please, how we worked up the statistics?—There are two kinds of failed crops—one is when the crops wither entirely, that is, regarded as *kharába*, then there is an estimate of the *kharába* when a good deal below the average. The *patwari* estimate what the *kharába* should be, and makes an area reduction according to his estimate.

4. *Q.* Is he a judge? He is the judge, but his work is supervised.

5. *Q.* (*The President.*)—As a matter of fact, is there a large reduction made on account of *khārába*? Yes, in some years.

6. *Q.* (*Mr. Wilson.*)—In column 2—*pakka* wells. Does this mean wells actually used in that year?—It means wells in working order in that year whether actually used or not.

7. *Q.* Does it include those that were not used in that particular year?—Yes.

8. *Q.* Is not the number of wells shown as actually in use in a particular year too large?—Yes, I think so, because it includes many wells in the irrigating area not used, because land is irrigated by the canal.

9. *Q.* Can you say how many wells are used in a year and how many are not?—I should have to call for that. The average area irrigated by *kachcha* wells is not more than one acre.

10. *Q.* In the case of *kachcha* wells, does the figure include *kachcha* wells not used for that year?—Yes.

11. *Q.* I understand that during the last 11 years the number of *pakka* wells in the Punjab has increased by 54,411?—Yes.

12. *Q.* And the number of *kachcha* wells by 31,000? —The number of *kachcha* wells fluctuates year by year.

13. *Q.* If you examine these figures, you will see that the number of *kachcha* wells except last year has not increased at all. Only this year (a dry year) have they increased?—Yes.

14. *Q.* In the case of *pakka* wells there has been a steady increase all through?—Yes.

15. *Q.* What do you estimate the average cost of a well in the Punjab?—I have not made that estimate.

16. *Q.* I estimate Rs. 300?—That would be a fair estimate.

17. *Q.* Then you give the average area cropped in two years 1891-92 and 1899-1900. Why those two years?—I chose 1891-92 because the cropped area was a normal one looking at the figures for the period of ten years; and 1899-1900 because it was a famine year.

[Mr. Sykes explained this point from a diagram in the Revenue Report.]

18. *Q.* According to the total average for the whole of the Punjab, the average area per well was 14 acres? —Last year only 12 acres.

19. *Q.* How is the decrease accounted for?—By the number of *kachcha* wells.

20. *Q.* Apart from the *kachcha* wells, do you expect an ordinary *pakka* well to irrigate more or less than the average in a famine year?—To irrigate more in a famine year.

21. *Q.* Take, for instance, the Jhang district, in which there are no *kachcha* wells—12 years is the average against 18 for a normal year. In the case of Delhi, the area went up from 7 to 10. In the case of Karnal district, the average area for a normal year is 9 acres in a dry year 14 acres?—Ordinarily speaking, in a dry year a *pakka* well is worked to the utmost and there is a tendency to spread well irrigation over a large area instead of confining it to valuable crops such as sugarcane and tobacco. The decrease of the average of a dry year in Jhang district is, I expect, due to the fact that the well area in that district is chiefly confined to the river circle, and the water level sinks in a dry year, so that the wells are not capable of irrigating to the same extent as in a year of good *sailab*. In Delhi and Karnal the average in the normal year in 1891-92 was large—a fact which may have been due to some change in statistics in that year. We have not separate statistics for *kachcha* wells, and the averages are therefore affected by the very large increase in the number of *kachcha* wells in use in a dry year; the area irrigated by a *kachcha* well is usually less than one acre.

22. *Q.* There has been during the past 11 years an increase of *pakka* wells in every district in the Punjab? I think so.

23. *Q.* (*Mr. Ibbetson.*)—Apparently from these figures there is a large general increase in the number of *pakka* wells in the Punjab. Do you think we should do anything to stimulate this increase?—I think so.

24. *Q.* What do you suggest?—We have made an inquiry as to where *kachcha* wells might be made. I am inclined to think an overseer might be appointed to advise whether a locality is favourable for construction of *pakka* wells.

25. *Q.* A Public Works overseer?—Yes. As regards *takavi*, I should prefer to reduce the limit of the period of protective lease and, instead of that, do away with interest on *takavi* loans to private owners.

26. *Q.* Would you reduce the period of exemption? —I should reduce the period of exemption.

27. *Q.* Not the period of repayment of loan?—No; I don't think so.

28. *Q.* (*The President.*)—Twenty years is the period of repayment of loan?—Yes, that is the usual period. I would have a register instead of the formal bonds. I was inclined to advise that on well-irrigated land which is also irrigated by canals the occupier's rate should be reduced.

29. *Q.* (*Mr. Ibbetson.*)—What would be the object of reducing the occupier's rate?—I think it is not fair to charge the full rate. A man who employs labour and keeps well-bullocks has much more expense in cultivation.

30. *Q.* Would not that mean that a man would use well-water for half a day and canal water for the rest of the season?—There would be danger from that.

31. *Q.* In that case it would be a direct encouragement to use canal water in part of the year when least needed?—In a country which is irrigated by a canal the subsoil water is raised and many more wells can be constructed in that area at less cost than before.

32. *Q.* I understand your point to be to charge rates that would encourage men to use wells and not use canal water?—To encourage men to use wells.

33. *Q.* (*The President.*)—You think if the difficulties attending the granting of the *takavi* advance procedure were made easier the advances would be more freely taken advantage of?—Yes; I think the object in making the procedure easier would be to stimulate the Deputy Commissioners in impressing

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the advantage of these advances on the people. Mr. Merk said he would go about with rupees himself. The Accountant-General would not, however, like that.

34. *Q.* If we could amend the tenancy laws to give more protection to tenants to spend capital—that would encourage them ?—No; I think not. The landlords would be deterred more than anything.

35. *Q.* It would do more harm than good ?—I think so.

36. Q. What do you think of the scheme of Government constructing wells at its own cost recouping itself by a rate? Do you think the scheme is likely to succeed ?—No.

37. *Q.* Why ?—I think the revenue arrangements would be very complicated for one thing.

38. *Q.* Do you think Government would do it as cheaply ?—No. The expenditure would be considerably greater. There would be friction between landlords and tenants. I am decidedly against it.

39. *Q.* (*Mr. Rajaratna.*)—Do you assess on the area of matured crops ?—If there is a 10-acre field and we see that the crop is perhaps a four-anna crop, then we take five and not ten areas as the cropped area.

40. *Q.* (*Mr. Ibbetson.*)—Allowance is made when it is below eight annas ?—Yes.

41. *Q.* (*Mr. Rajaratna.*)—The estimate is made by the *patwaris*. The amount of supervision exercised is practically very little ?—Yes, I am afraid it is.

42. *Q.* How many wells were constructed from State loans ?—I have not the figures here.

43. *Q.* Is the area of double-cropped land increasing ?—Yes.

Mr. L. Laville.

MR. L. LAVILLE, Assistant Secretary to the Punjab Government, Financial Department.

(*Lahore, 29th October 1901.*)

Memorandum I. On Land Improvement Loans.

(Not printed.)

1. *Q.* (*The President*)—You say in paragraph 4 of your note "the existing rules provide for the grant of Land Improvement Loans and Agriculturists' Loans without interest or at a reduced interest in special cases." These do not apply to *takavi* advances; do they ?—Yes, they do; our rules provide for the grant of such loans without interest.

2. *Q.* Can the Local Government sanction broadcast loans for the construction of wells without interest ?—That question has never come before me.

3. *Q.* We have heard of 6¼ per cent. being the rule. You mention 4 per cent. Is it optional with the Local Government to change the interest and charge less ? I wrote of the 4 per cent. rate in connection with loans to Municipalities, District Boards and Landholders only. But it is optional with the Local Governments to charge less than 6¼ per cent. on *takavi* advances in special cases.

Mr. Wilson read to the Commission the rule bearing on the subject and remarked—that means special rules in special cases.

4. *Q.* (*The President.*)—As a matter of fact, it is not availed of in the case of advances for wells ?—Not to any great extent.

5. *Q.* (*Mr. Higham.*)—Under your Provincial Contract the Province gets Rs. 45,000 for expenditure on new provincial works ?—Yes.

6. *Q.* In addition they get the whole of the direct revenue on existing provincial works?—Not in addition. The direct revenue has been assigned to us wholly; it is Rs. 35,000 in excess of the expenditure on maintaining the works; that Rs. 45,000 is given as a grant for the construction of new works.

7. *Q.* Practically you get the whole of the direct revenue assigned to you and pay working expenses and have Rs. 45,000 for the construction of new works ?—Yes.

8. *Q.* But you cannot undertake any works at all? —We have not been able to spend the Rs. 45,000 on new works because we have wanted the money for famine and plague purposes.

9. *Q.* Have there been any applications for money? —I know one scheme that has been postponed for want of money; that is the Hazarkhani extension of the Kabul river canal. That would probably have been constructed if the Rs. 45,000 had not been required for famine and plague expenditure.

10. *Q.* If you have money available that you don't want for famine and plague purposes, there is nothing in the present arrangement to discourage the Local Government from allotting it ?—No; I think not.

11. *Q.* Whatever extra revenue they make in consequence, their expenditure might expand in proportion ?—Yes; and as in each fresh contract their allotment of revenue would be not less than their expenditure, they would recover the net revenue from their new canals.

12. *Q.* The Government of India would always give you a grant for your expenditure. They would not allow you the whole of the future revenue, but only as much as was required to cover expenditure?—Our assignment of revenue would be limited to the amount of our expenditure, but it would not be less If therefore during the currency of each contract we utilized to the full all the revenues assigned to us, including all the fresh revenue derived from the canal works, we must necessarily in each fresh contract get the net revenue from those works.

13. *Q.* With regard to the Western Jumna Canal, you won't get the whole of the receipts of the Sirsa Branch; but only as much as Government of India likes to give?—I understand we should get the whole of the receipts; the proposal of the Finance Committee was that these specially provincialized works should remain outside the contract.

14. *Q.* If you get the whole of the receipts they will be outside the contract?—That is how I understand it.

15. *Q.* Will it remain outside the contract ?—Yes, I understand that to be the proposal of the Finance Committee.

16. *Q.* Supposing you lost, you cannot pay the interest ?—We should have to divert some of our revenue from the ordinary Provincial contract to cover the loss.

17. *Q.* Might it be for all time outside the contract ?—Yes.

18. *Q.* If they give you revenue on one head and retain it under another, where is the responsibility? —These works are designed as productive works; we should upon a given number of years always make a profit out of them; taking year by year the loss of one year would be made good out of the profit of another; but the result on a series of years would, I should think, if the works fulfilled the estimated expectations of them, certainly be a gain.

19. *Q.* Supposing the canal was a losing business? —Then, presumably, we should set about re-adjusting the accounts of the canal, we should have to reduce the maintenance expenses.

20. *Q* If you made a large profit in five years would not that reduce the assignment?—I should not expect that to do so. I expect the Government of India would call upon us to spend all the profits on works of a similar kind.

21. *Q.* (*Mr. Ibbetson.*)—The profit made on the Provincial Loan accounts goes to the Government of India at the end of the contract unless the Local Government absorbs it? Yes, that would be so; but I should explain that there has not, on the contract, as a whole, been any profit to the Local Government from the loan account; if you refer to the last paragraph of my note, you will see that the profit has been assigned to us for expenditure.

22. *Q.* It is accounted for in the contract?—Yes.

23. *Q.* During the current contract you made Rs. 49,000?—Yes.

24. *Q.* As regards the Sirsa Branch, it is a Provincial work. Would the maintenance expenses of the canal so provincialized include a charge on account of water delivered at a point at which the branch takes off from the main canal?—I do not know, but believe there would be no such charge.

25. *Q.* As regards the management of the Sirsa Branch, is it kept separate and paid for separately? —I do not know.

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26. *Q.* (*Mr. Wilson.*)—It has not been provincialized?—No. The engagement was that it might be provincialized after ten years of working; it has been working for ten years now.

27. *Q.* With regard to what you said to Mr. Higham, the question is so important that I must ask you to look at paragraph 4 of the note on Provincial works, where you say it says "every such arrangement the Finance Committee contemplated would be a separate and subsidiary one not part of the regular Provincial contract; first because it is obvious that its duration must be fixed on special considerations and may or may not be the same as that of the regular contract." Is not that an arrangement by which the Imperial Government provides funds and does not ask for interest during the non-paying time of a work and is not that the period for which the contract would be made?—No, I do not understand it so. The Provincial Government would have no financial interest in the canal during its construction; after it had been working ten years it might become a Provincial work; the period for which Provincial would take it over a different period from the ten years spoken of with regard to construction.

28. *Q.* Has not the Provincial Government some concern with the interest?—It would be added to the capital charge for which Provincial became liable.

29. *Q.* The Provincial Government is concerned with the interest though it does not pay it?—Yes.

30. *Q.* I understand that to avoid the difficulty which the Provincial Government finds in paying interest on a work which is returning nothing for a certain period an arrangement was made by which the Imperial Government would pay that interest, but for that period the whole transaction would remain outside the contract; at the end of that period the arrangement would cease and it would then go into the Provincial contract, you think that wrong?—Yes.

31. *Q.* If it is as you think, it is all we want?—I think so.

32. *Q.* You say that Government have gained on the Provincial loan account Rs. 49,000 a year besides paying 3½ per cent. interest?—Yes.

33. *Q.* You said that ultimately, at all events, the Rs. 49,000 go to the Government of India?—Yes, because in the contract it is appropriated for other Provincial expenditure.

34. *Q.* If the rate of interest were reduced from 6¼ to 4 per cent., the Rs. 49,000 would disappear?—It would be 3½ per cent.; that is the interest we now pay to the Government of India.

35. *Q.* Ultimately under the Provincial contract system would that loss be incurred by the Provincial Government or the Government of India?—It would depend upon whether we surrendered the interest of our own motion or by agreement with the Government of India. I should expect the loss to be made good to us in the next contract. This gain is really a grant to us to meet Provincial expenditure of a general kind. If we surrender the interest, we practically give up a grant for general Provincial expenditure; in other words, we should have to be satisfied with a grant running below our expenditure to the extent of Rs. 40,000.

36. *Q.* If the Government of India agreed to forego the interest, there would be no loss to the Provincial Government?—No, there would be no loss; the Government of India would presumably assign to us the same amount of revenue derived from some other source.

37. *Q.* I think the loss in the last ten years on non-payment of loans comes to one per thousand?—I have not made the calculation, but the loss would be small.

38. *Q.* It would be quite insignificant?—Yes.

39. *Q.* If the Government of India agreed that such loans might be given free of interest, how would that work as between the Imperial and Provincial Governments? Suppose the Government of India agreed that the Punjab Government might give Rs. 10 lakhs a year for the construction of wells free of interest? It would not affect the account between Imperial and Provincial:—So much revenue and expenditure would disappear from the Provincial accounts.

40. *Q.* Is it not the case that, during the famine, land improvement loans were practically stopped throughout the Province?—I cannot say. There has been no great reduction in the grant of loans since 1895-96.

41. *Q.* You said that one scheme for a Provincial work had been held in abeyance for want of funds?—Yes.

42. *Q.* Is it not the case that the Local Government was unable to advance Rs. 18,000 for a survey in Dera Ismail Khan?—Yes. The money has been allotted in the current year, but as far as I can judge the project would have been thrown out for want of funds, if it had been brought forward earlier.

43. *Q.* Supposing at this moment a scheme were worked out costing Rs. 10 lakhs and promising a good return, could the Local Government advance the money?—No, they could not take it up.

44. *Q.* Would it be difficult to get such a grant from the Government of India?—They would have to give us a loan or make the work and then provincialize it.

45. *Q.* The Provincial Government is not in a position to start by itself a large scheme of that kind?—No.

46. *Q.* Nor even to undertake a large survey?—No, not an expensive survey.

47. *Q.* Are any District Boards likely to take up a scheme costing 1 lakh?—No District Board has money enough for that.

48. *Q.* What has been the financial result to District Boards of such canals as they have taken charge of?—The two District Boards that have constructed canals have made a profit—Peshawar of 20 per cent. on the Michni-Dolazak branch of the Kabul river canal and Karnal of 1¼ to 1½ per cent. on the Sirsuti canal.

49. *Q.* Were these canals constructed at the cost of the District Board?—Yes, from loans advanced by the Government of India, the Imperial Government.

50. *Q.* What interest do they pay?—Four per cent.

51. *Q.* Would there be any difficulty in another District Board getting a loan in order to construct canals?—I believe not. We had no difficulty in securing these particular loans of Rs. 94,000 to Karnal and Rs. 25,000 to the Peshawar Board.

PANDIT HARI KISHEN KAUL, Settlement Officer, Muzaffargarh.

(*Lyallpur, 1st November 1901.*)

Pandit Hari Kishen Kaul.

Note by witness on the Inundation Canals of the Muzaffargarh district.

(Not printed.)

1. *Q.* (*The President.*)—You are Settlement Officer of Muzaffargarh?—Yes.

2. *Q.* How long have you been there?—3½ years.

3. *Q.* Have you had any famine troubles there?—No, none.

4. *Q.* Have you ever had any famine experience?—No.

5. *Q.* You have a very large area under inundation canals?—Yes.

6. *Q.* You say in your note "the amount of clearance to be done was decided by a committee of *Sarpandus* and the labour distributed over the irrigators." Do you think that system is practicable now?—No. I don't think so; that is why I proposed that the system should be abolished and occupiers' rates substituted.

7. *Q.* You think the *chher* system would not work?—I think not; there are many difficulties; besides, the system of charging a certain rate of statute labour on the irrigated area is not satisfactory.

8. *Q.* Besides that, do you think it does not work fairly as between the poor and rich?—Yes, there are many abuses.

9. *Q.* I talk of some experience of Egypt. Eighteen years ago there was statute labour to the extent of 250,000 men employed for six months in the year, and there the whole work of clearance fell upon the

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peasant proprietors. Was that the case here?—Exactly the same thing happened. The wealthy did not contribute at all, and the burden fell on the poor.

10. *Q.* As regards the management, do you think there is not the same amount of self-help among the agricultural classes as there was?—I am inclined to think there was never self-help among the zamindars here; local officers interested themselves in the irrigation; they turned the men out to see the canals cleared, and made them contribute towards any extensions that were necessary; but for the help of these local officers, the zamindars would never have done much.

11. *Q.* Inundation canals cease to run about September?—Some cease to run about September; some go on to the beginning of November; two canals are running now, and I expect they will go on throughout the winter.

12. *Q.* Right on to the next floods?—Yes.

13. *Q.* Have these canals been dug to an extra depth?—No, they used to run throughout the winter, even in past years.

14. *Q.* The *rabi* cultivation is started with irrigation?—Yes.

15. *Q.* How do they manage after that?—The canals run long enough for the *rabi* lands to be ploughed up; after that, they help the cultivation with wells.

16. *Q.* Are there sufficient wells to take up irrigation that has been begun by canals?—Very nearly.

17. *Q.* What is about the depth of water below the surface?—5 to 30 feet.

18. *Q.* Not more than 30 feet?—No.

19. *Q.* There are an immense number of wells?—Yes.

20. *Q.* All *pakka*?—Most of them are *pakka*.

21. *Q.* (*Mr. Wilson.*)—There are 15,000 *pakka* wells and 2,400 *kuchcha* wells in Muzaffargarh. How long do these wells last,—about 100 years?—I don't think the average life is more than 100 years.

22. *Q.* (*The President.*) People must have valuable oxen to work these wells?—No, they are not at all strong.

23. *Q.* (*Mr. Ibbetson.*)—Is the Persian wheel generally used?—Yes.

24. *Q.* (*The President.*)—Would it be a good think for the country if these inundation canals were made perennial so as to take the place of the wells?—It would.

25. *Q.* Would it extend cultivation?—To a very considerable extent.

26. *Q.* You don't think that there are certain advantages in wells?—I don't think cultivation is possible in this tract without canal water. I don't think many people would refuse to take canal water.

27. *Q.* You have very little rain?—5 or 6 inches in the year.

28. *Q.* Will it be a popular change if you abolish this statute labour and substitute for it occupiers' payment?—When I proposed this change, everybody seemed in favour of it; but now that I have made it, many people don't like it; my idea is that, on the whole, the substitution of occupiers' rate for statute labour is much better for the people.

29. *Q.* Is there difficulty about getting the *chher* men to work?—In some cases they don't turn out to work; for example, during the *rabi* ploughings and during the harvesting operations there is great difficulty.

30. *Q.* You would find it difficult to get paid labour also at harvest time?—Yes.

31. *Q.* Is the question of head-works at the entrance of the canal a difficult one? Is much money spent on training the river past these heads?—No, a change is made where there is an erosion.

32. *Q.* Are there any regulators at the heads of the canals?—Not many.

33. *Q.* If you have a regulator, you cannot change the head?—On the Indus we have a system of side channels; most of these canals take off from these, which don't change.

34. *Q.* They don't get silted up?—Very rarely.

35. *Q.* Are the sand-hills an undesirable obstruction to irrigation?—Not as far as my district is concerned.

36. *Q.* In Muzaffargarh you would welcome the Sind-Sagar Canal?—Yes.

37. *Q.* The effect would be to totally remodel these canals?—Yes.

38. *Q.* Supposisg there was no Sind-Sagar?—I have made my proposals in my note. I would extend the Mohanwah (explained on map).

39. *Q.* How much irrigation is there on that canal?—250,000 acres, of which one lakh would be quite cultivable.

40. *Q.* If that canal were made, would you want a weir across the river?—No.

41. *Q.* Is it taken out of a creek?—Yes.

42. *Q.* Has there been any proposal made in this matter?—Yes, a rough estimate.

43. *Q.* Has this been surveyed for?—Yes, roughly.

44. *Q.* Is the land very fertile?—Fairly so; indigo, wheat, and sugarcane are grown.

45. *Q.* Do they use manure?—They cannot do anything without manure; they require it for the *rabi* crops—ordinary cattle manure.

46. *Q.* Without manure, they could not get a crop at all?—No, they get *kharif* crops without it, but for *rabi* they require it, and for sugarcane.

47. *Q.* Is the silt fertilising?—Yes.

48. *Q.* They don't require manner for the *kharif* crops?—No, some of the crops don't require manure, neither rice nor indigo.

49. *Q.* Which has the best silt, the Indus or Chenab?—The Chenab is much the better.

50. *Q.* Do you think any improvements can be introduced in the *takavi* system to make it easier for a man to make wells?—I think there are some improvements that can be introduced.

51. *Q.* What can you suggest?—That the full term allowed for the repayment of the loan should be utilized, it is not utilized now.

52. *Q.* The Deputy Commissioner does not give as much time as Government allows him to give?—Exactly. I have examined the records, and find that in some tahsils the term is 7½ years, in others, 11½.

53. *Q.* Does that depend on the personal opinion of the Deputy Commissioner for the time being?—I think so. I think we should give the full period of 20 years.

54. *Q.* Do you happen to know what the feeling of the Deputy Commissioners was, why they did not give a longer time?—Because the rules say that the loans should be repaid in as short a time as possible; and I don't think besides that the calculations are correctly made; a well in the Thal costs Rs. 300, and does not irrigate more than 10 acres—10 acres in the Thal cannot produce more than Rs. 80 worth of crop, or Rs. 20 in rent—to the landowner. Recovery in 11½ years would mean an annual payment of Rs. 21 or more than the loan produces. Then again my second point is:—Under the rules, inquiries can be made by the Kanungo; all the inquiries should be made by the Tahsildar or Naib Tahsildar unless the work is very heavy.

55. *Q.* (*Mr. Ibbetson.*)—Would that mean much delay?—I don't think it should, because in the last 10 years the largest amount of *takavi* distributed in my district, for example, was only Rs. 7,144.

56. *Q.* Suppose there were many applications that might mean delay?—Yes.

57. *Q.* (*The President.*)—Is there any complaint of the rate of interest—6¼ per cent.?—There is no complaint, but I believe it would be a great inducement if the interest were reduced.

58. *Q.* Do you think there would be a large increase in the number of wells if greater facilities were given?—There would be a certain increase, but not very much; they want it to supplement the *rabi* cultivation, not the *kharif*. If a perennial canal were made, there would be no necessity for extension of well irrigation.

59. *Q.* It would not do to make the Mohanwah into a perennial canal?—I am afraid it would be very difficult to build a weir there; it would be a good thing if it could be done.

60. *Q.* We heard the opinion the other day that the time of inundation canals has come to an end; have you any opinion on the point?—That is not the case in Muzaffargarh; inundation canals have worked very well there.

61. *Q.* Have you any other suggestions to make as regards the increase in the food-supply of your district?—None, except the extension of canals.

62. *Q.* What about food for cattle; do you think there is any way of extending the pasture ?—I think we should reduce the pasture; we should bring land under cultivation, and have fodder crops instead of grass.

63. *Q.* For sheep as well as for oxen?—Sheep are fed on the leaves of trees and on shrubs.

64. *Q.* I suppose fuel is very largely burned?—Yes.

65. *Q.* Are there many trees in your district?—Any number.

66. *Q.* I suppose they do burn manure ?—Yes, but ours is a very good tree-growing district.

67. *Q.* (*Mr. Ibbetson.*)—Still they burn manure?—Yes, in some places.

68. *Q.* (*The President.*)—What is the proportion of *kharif* to *rabi* cultivation?—It is half and half.

69. *Q.* If the inundation canals were larger, would there be an extension of *kharif* ?—I think it would increase the *kharif* as much as the *rabi*; the *rabi* is the crop the people like most.

70. *Q.* (*Mr. Ibbetson.*) Do they grow wheat?—Yes, wheat is said to pay the bania; indigo the revenue, and cotton to clothe the people.

71. *Q.* (*The President.*)—An extension of inundation canals could not be undertaken unless there was also an extension of wells ?—Quite so; if the canals extend, the wells will increase.

72. *Q.* Do you think it would be a good thing for the district if money were spent in extending these inundation canals ?—Yes.

73. *Q.* It would require a large sum ?—I have put down the sum in my note.

74. *Q.* You think an extension of 139,000 acres would be sufficient for the wants of the district?—Yes, I think it would.

75. *Q.* (*Mr. Higham.*)—You say the area irrigated in the last settlement was about 200,000 acres?—Yes.

76. *Q.* What was the revenue assessed on that?—The revenue credited to Government canals was Rs. 2,27,000.

77. *Q.* Your area has now increased?—Yes, to 333,000 acres.

78. *Q.* Has there been a corresponding increase in the revenue?—No, because it is mostly fixed.

79. *Q.* Do you know what are the areas of fluctuating assessment?—I could not say.

80. *Q.* What is the incidence of *chher* labour; how many men do you require ?—A little over two for an acre.

81. *Q.* For how long ?—For one day, the work goes on for 90 days.

82. *Q.* What do you fine a man if he is absent?—Eight annas; we value a man at 5 annas 4 pies per acre for labour cess; the value of the *chher* labour is only 4 annas, and we fine him double.

83. *Q.* When do clearances begin ?—About November or December.

84. *Q.* What is the land revenue per acre?—It varies from circle to circle; the highest *nahri* rate is Re. 1-11 an acre and the lowest is Re. 1-2. The incidence of *chher* on the Chenab Canals is higher than on the Indus.

85. *Q.* Why?—There is more work required on the Chenab Canals.

86. *Q.* You said that some canals run throughout the winter season ?—Yes, this year there are two.

87. *Q.* Are there often more than two running ?—I have not seen more.

88. *Q.* When are the other canals open ?—In April or May.

89. *Q.* Is not a part of this district liable to floods that ruin the crops?—Only *bet* circles; the whole district is protected by embankments, and the district can be flooded only when they give way.

90. *Q.* In the Thal where the sand-hills are, what percentage of the villages is regarded as cultivable?—About 40 per cent. of the area.

91. *Q.* Do you think you could irrigate 10 per cent. in the Thal vilages?—Yes; that is also the opinion of the Executive Engineer.

92. *Q.* To irrigate that amount, I suppose the whole area that is irrigable would have to be cropped in the year; there would be no fallow?—Very little fallow.

93. *Q.* It is as much as you can do to get 40 per cent. out of the villages?—Yes, with an inundation canal.

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94. *Q.* Do these sand-hills move about much?—No.

95. *Q.* Have any facts been noted about them ?—No observations have been made.

96. *Q.* What do the natives say?—They say that they remain in one place; most of them have trees growing on them.

97. *Q.* Suppose these inundation canals are made perennial and the working of the wells stopped by the opening of the Sind-Sagar, do you think the effect would be bad; would there be water-logging ?—I am afraid the water-logging would get worse.

98. *Q.* You would put more water into the canals in the flood season and nothing during the cold weather?—Yes.

99. *Q.* What would be the effect ?—It would not be very bad in the whole district, but in the low parts the effect would be bad.

100. *Q.* (*The President.*)—I suppose you would prevent that by drainage?—Yes; drainage might be a remedy; I have not any plans about it.

101. *Q.* (*Mr. Higham.*)—You have groups of canals, have the people any voice in their management?—Yes, they have committees, and they are consulted as regards clearances.

102. *Q.* Their functions are simply to advise the Executive Engineer or to make representations to him?—Yes.

103. *Q.* (*Mr. Wilson.*)—You said you don't think the people could manage the canals by themselves?—Yes.

104. *Q.* You said before British rule the canals were more or less managed by the rulers of the country ?—Yes.

105. *Q.* When British rule first began, the people were allowed to do everything themselves?—Yes.

106. *Q.* What was the result?—Utter mismanagement.

107. *Q.* They could not get on without official help?—No, that is why the Deputy Commissioner took the canal management over.

108. *Q.* What was the result of that?—The management was improved to some extent; the Tahsildar was put on the canals, but still there were complaints; eventually representations were made to Government, and the management was made over to the Irrigation Department.

109. *Q.* (*Mr. Ibbetson.*)—Who made the representations?—The District authorities.

110. *Q.* (*Mr. Wilson.*)—What was the result of management by the Irrigation Department?—Very satisfactory, you can see it in the increase of cultivation.

111. *Q.* You have made a calculation of the result to Government, from improvements in canals, in increased land revenue during the currency of the settlement; you begin by taking as the amount to be credited to canals as Rs. 2,27,520; is it not the case that Mr. O'Brien over-estimated the amount of canal irrigation that was going on in the district?—Possibly; I cannot say for certain.

112. *Q* Yes, it was very high. As regards these future schemes, you estimate that the extensions are to be assessed at Re. 1-2 per acre; why is that?—That is about the rate that will be charged in the Sinawan Bet and the Alipur Chahi Sailab Circles on extended canal irrigation.

113. *Q.* Will the occupiers' rate mean a saving to Government ?—I have said the occupiers' rates would leave a margin. Occupiers' rates are supposed to cover working expenses only, and we have left a small margin as canal irrigation.

114. *Q.* On what grounds have you estimated occupiers' rates?—It was decided that, whenever the occupiers' rate was introduced, it should be sufficient to cover working expenses.

115. *Q.* You have proposed different rates on the Indus and Chenab Canals?—Yes.

116. *Q.* Why?—The silt of the Chenab is more fertilising; that of the Indus is poor; and at present the incidence on the Chenab is far heavier than on the Indus.

117. *Q.* You have proposed that the more valuable crops should bear heavier rates ?—Yes.

118. *Q.* Hitherto on each acre of crops there was a uniform rate?—Yes.

119. *Q* Are these rates that you propose equal to the rates charged elsewhere on inundation canals in

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the Punjab?—They are lower than in Multan and Montgomery.

120. *Q.* If Government makes a new canal or an extension of an old one in a new country, should the new irrigation pay such low rates as this?—Yes, on extensions, not on a new canal.

121. *Q.* They might be charged higher occupiers' rates?—Yes, but not so high as elsewhere.

122. *Q.* To your estimate of the credit to Government might well be added enhanced occupiers' rates?—Yes.

123. *Q.* And the improvements promise more than you estimate here?—Yes.

124. *Q.* According to the statement here, in Muzaffargarh in the last 10 years 3,500 new wells have been made?—No, these figures include old wells put into working order as well.

125. *Q.* How many new wells were constructed in the last 10 years?—Perhaps 2,000.

126. *Q.* What is the average cost of such wells?—Rs. 250.

127. *Q.* In the last 10 years the people of the district have spent Rs. 5,00,000 in the construction of new wells?—Yes, roughly.

128. *Q.* Has Government spent anything on the construction of the wells?—No.

129. *Q.* What benefit will Government derive from this?—About Rs. 6 per well.

130. Q. So that Government will gain Rs. 12,000 by the construction of these wells in the last 10 years?—Yes.

131. *Q.* How much *takavi* has been spent in the last 10 years?—Rs. 27,415.

132. *Q.* While the people have spent Rs. 5 lakhs?—Yes.

133. *Q.* You spoke about irrigation in the Thal by means of canals among the sand-hills, do any canals irrigate such country now?—Yes; nearly half the Nahri Thal of Sinawan is so irrigated and more than half the Muzaffargarh Thal.

134. *Q.* Is that country similar?—Yes.

135. *Q.* Have you had any complaints about canal water failing through the canals being choked up by sand?—Only one complaint in connection with a water-course.

136. *Q.* You say manure is required in the Thal; is not the indigo stalk good manure?—Yes; but they require other manure as well.

137. *Q.* There are embankments to keep out floods?—Yes; there are embankments on the Indus side and wherever necessary on the Chenab.

138. *Q.* Are they complete now?—Yes.

139. *Q.* Do they often breach?—No, no great expenditure is required to maintain them.

140. *Q.* Has the Indus moved much in any direction in the last century as far as you know?—It has moved west.

141. *Q.* Over a large tract of country?—About 10 miles in some parts of the country; in some places it has gone to the east a few miles.

142. *Q.* There has been some water-logging; has there not already?—Yes; but it is very much better; there has been none this year.

143. *Q.* What is that improvement due to?—Better management of the canals and want of rain.

144. *Q.* It is not due to drainage?—No.

145. *Q.* Is it possible to remedy water-logging by drainage?—Yes; but in the particular tract in which it occurred last it is almost impossible, because it is a hollow.

146. *Q.* You spoke about a perennial canal taking the place of inundation canals; would that increase the danger of water-logging in this low country?—I don't think so.

147. *Q.* Could not the perennial canal be kept out of this low country, allowing it to be worked by inundation canals only?—It would be difficult to work two sets of rates.

148. *Q.* Do you consider it advisable to construct regulators?—Yes.

149. *Q.* Why?—For the better management of the canals, extension of cultivation, and larger income.

150. *Q.* In what form?—In the form of the fluctuating rate that we propose to impose on the land; at the expiry of the settlement, it will result in an increase of land revenue.

151. *Q.* There has been a great waste of labour in the construction of parallel water-courses?—Yes, that is being remedied now partly at the cost of Government.

152. Q. Have the water-courses got masonry outlets?—Not yet; they are being built; the arrangement is that Government should build masonry outlets for the existing channels.

153. *Q.* What would be the result?—Better control of the water, and its spread over a larger area.

154. *Q.* A larger duty out of the water?—Yes, and higher income from occupiers' rates.

155. *Q.* Do you think that the expenditure incurred by Government on these water-courses, masonry outlets, and regulators will bring in a net increase of revenue up to 5 per cent. on that outlay?—I have no figures, but I think it should be from 4 to 5 per cent.

156. *Q.* Why have these improvements not been made before?—They were not thought of.

157. *Q.* (*Mr. Rajaratna.*)—With reference to what you said about the difficulty of working two sets of occupiers' rates, what is the difficulty?—There is always complication in accounts in working two sets of rates.

158. *Q.* I suppose the area under each canal will be known?—The chance of error would be greater.

159. *Q.* That can be prevented by supervision?—Yes, perhaps so.

160. *Q.* On what principle are enhanced occupiers' rates charged on certain crops?—They are more profitable. It is fair to charge higher rates on the better crops and lower rates on the less valuable; that is not the sole reason, rice takes a large quantity of water. and so has to pay more.

161. *Q.* In making the settlement did you reserve power to impose enhanced water-rates when new irrigation works are constructed?—I don't think it is necessary; the occupiers' rates can be revised every 5 years.

162. *Q.* During the currency of the settlement no revision is made?—Fixed land revenue is not enhanced during the currency of settlement.

163. *Q.* Are occupiers' rates not credited to the canal?—Yes, they are.

164. *Q.* And owners' rates as well?—Yes.

165. *Q.* Have you any separate land assessment in addition to occupiers' rates?—I have no owners rates; for waste land I have proposed a fluctuating water advantage rate.

166. *Q.* Is the land assessment where new lands are brought under cultivation also credited to canal?—Yes.

167. *Q.* (*Mr. Ibbetson.*)—I understand that you don't consider Muzaffargarh to be liable to famine?—No.

168. *Q.* About the *chher* system, I understand that work begins in December and continues for three months?—There are three terms of one month each, but there are intervals between; it goes on to April.

169. *Q.* With regard to the alteration from *chher* to cess, why has it been necessary to change what seems the best thing for the people?—In the first place, the distribution of the *chher* system was very uneven; and, in the second, the moharrirs who worked the *chhers* were very difficult to control.

170. *Q.* You are satisfied that it is for the benefit of the people to change the *chher* to water cess?—Yes.

171. *Q.* You say in your note that wells, when independent of canal irrigation, are no protection against drought because you cannot work them profitably in a year of drought, why?—They cannot irrigate a sufficiently large area.

172. *Q.* Why?—The land in this district consists of a thin stratum of soil which does not hold water; if you don't water the crops frequently, they dry up.

173. *Q.* Do you mean that a well, to be used profitably, must have rain or canal water to help it?—Yes.

174. *Q.* In years when there is no rain, I suppose it is doubly profitable in so far as it helps the people to withstand drought?—Yes.

175. *Q.* What obstacle is there to their extension in the Thal?—It does not pay as well as before.

176. *Q.* Do you think want of manure has anything to do with it?—Yes.

177. *Q.* Do you think that a man is prevented from making a well by fear of the wet assessment that will be put on after 20 years?—No.

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178. *Q.* Do you think the 20 years' term is sufficiently liberal for exemption?—I think so.

179. *Q.* That does not prevent extension?—No.

180. *Q.* As regards wells that supplement canal irrigation, you propose measures which would lead to an extension of canal irrigation; will there be any difficulty in constructing the number of wells necessary to supplement that irrigation?—I don't think there should be.

181. *Q.* There has been considerable canal extension in the past; have wells kept pace with it?—The canal-irrigated area has risen faster than the wells.

182. *Q.* Supposing Government should adopt measures to induce people to construct wells, would it materially assist the extension of well irrigation?—Yes.

183. *Q.* Do you think the 6¼ per cent. interest has prevented people from making wells? No: people would have to pay much more to a bania.

184. *Q.* When you say that you think more liberal offers of assistance might promote wells, what are you referring to? What inducements would you offer, supposing you had power to do what you liked?—I would reduce the interest to half what it is now and would make it easier for people to get *takavi* than now; our main difficulty has been that during past two or three years there has been no money to give; and I would rule that the revenue officer should settle the matter on the spot and pay out the money while in camp.

185. *Q.* As regards the re-payment, the shorter that term the less is the total interest paid; is not the short term often asked for by the borrower?—Yes, people like to get rid of the debt. I should besides like to call the attention of the Deputy Commissioner to the suspension of these instalments; they are seldom given, and this works very hardly.

186. *Q.* You say that indigo is a valuable and extensively grown crop?—Yes; but I am afraid that it will not be valuable in future.

187. *Q.* (*The President.*)—Has any reduction occurred?—Yes.

188. *Q.* On account of German competition?—Yes.

189. *Q.* (*Mr. Ibbetson.*)—Have you had any trouble about the supply not coming on in time?—Occasionally.

190. *Q.* Is indigo kept down by that uncertainty?—Yes, to some extent.

191. *Q.* Your scheme would remedy that?—Yes.

192. *Q.* Is there any difficulty in making wells as to being sure that you will find water; sometimes a man starts a well and has to give it up?—Yes.

193. *Q.* Could any help be given him by the use of boring tools?—It has not been tried.

194. *Q.* Do you think it might help?—Yes.

195. *Q.* It has been proposed by responsible people that Government should themselves construct wells with the consent of the owners in private lands and recover their money by a rate on the irrigated area; do you think that scheme would work?—I don't think the people would like it.

The Honourable Mr. SIDNEY PRESTON, Chief Engineer and Secretary to the Government, Punjab.
(*Lyallpur, 2nd November 1901.*)

Mr. S. Preston.

Memo. of subjects on which witness proposed to give evidence.

1. Will advocate the restriction of irrigation in tracts which already irrigate a very high percentage of the cultivable commanded area, or in which the spring water level is high, in order to provide water for tracts which at present receive no irrigation.

2. Will present a special note, and plans to exemplify it on the necessity for larger grants for the development and improvement of the inundation canals by the construction of distributaries, stop dams, outlets, etc., so as to bring them into line with the perennial canal systems.

3. Will advocate the entire management of the inundation canals, including the measurement and assessments, being in the hands of this department so as to place its officers in immediate touch with the zamindars.

4. Will bring to the notice of the Commission the necessity for constructing more weirs on the Sutlej, Chenab, and eventually the Indus, so as to assure the early and late *kharif* waterings to the inundation canals, which must gradually be affected as regards date of opening and closing by the withdrawal of water for the perennial canals.

5. Will advocate the provincialization of the canals, so that the province may have a direct pecuniary advantage in its development.

6. Will be prepared to explain, amplify or be examined on the notes already written and laid before the Commission on the existing and proposed irrigation works.

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1. *Q.* (*The President.*)—You are Chief Engineer of the Irrigation Department in the Punjab?—Yes.

2. *Q.* How many years have you held your present post?—I acted for Mr. Beresford for seven months in 1898 and have had permanent charge from February 1900.

3. *Q.* Before that time you were acting as Chief Engineer in the North-Western Provinces?—Yes, for 13 months.

4. *Q.* Before that where did you spend your service?—I have served on all the perennial canals in the Punjab except the Western Jumna Canal, but never on any of the inundation canals; I know them academically, but have no practical knowledge of them.

5. *Q.* Have you had any practical famine relief under you?—None whatever. The question of famine administration came up after the 1897 famine, and it was decided, with the concurrence of His Honour the Lieutenant-Governor, that it should be under the Roads and Buildings Branch. In some cases we give professional advice with reference to irrigation matters, but the work is in their charge.

6. *Q.* A large number of labourers were sent up from Hissar to Jhelum, who did that?—That was done by us; Mr. J. N. Taylor did it under the orders of Mr. Field.

7. *Q.* Have you any reason to regret the transfer of the famine administration to the Roads and Buildings Branch?—I think it is eminently right. I plume myself on having got rid of the famine work, my reason being that during a famine irrigation men are hardest worked to make a reduced supply as far as possible, while the grants of the Buildings and Roads Branch being reduced sets the men free.

8. *Q.* Can you speak of the other Provinces?—No.

9. *Q.* The only analogous one would be the North-Western Provinces?—Yes.

10. *Q.* You advocate "the restriction of irrigation in tracts which irrigate a very high percentage of the cultivable commanded area, or in which the spring level is high, in order to provide water for tracts which at present receive no irrigation." I understand that that practically has been done on some of your canals?—Yes, I don't know whether I am at liberty to comment on a note by Mr. Wilson.

(*Mr. Wilson.*)—I have no objection.

(*Witness.*) The Bari Doab is rather an instance in point I first took up the question in 1898. It has taken three years to get the Revenue authorities to agree; there has been a very long controversy; I have all the papers bearing on it, and if you wish them put in could do so. The difficulty has always been that the Revenue authorities say "you will upset our settlements." I think they should revise them if necessary. Personally I was very glad to see the remarks that Mr. Wilson has made in his note. I think it shows a tendency on the part of the Revenue officers to alter the procedure hitherto observed in the case of the Western Jumna and Bari Doab Canals. In his last paragraph Mr. Wilson advocates practically what I do.

11. *Q.* (*The President.*)—What does he advocate? He says that "where the rainfall is good or the underground water level sufficiently near the surface to make irrigation from wells practicable, canal water in the winter season should gradually be refused." That is—he advocates the withdrawal of water from one tract that is highly irrigated, as in the case of the Bari Doab Canal, or where the spring level is high. This is what I have been advocating for some time.

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12. *Q.* On the Western Jumna Canal it has been done largely?—Yes; there was a great discussion when Colonel Jacob tried to carry out the extensions. He was eager to push the Western Jumna Canal into Rohtak, Hissar and Sirsa. Sir Denis Fitzpatrick said we had obligations to the Delhi cultivators who had a prior claim to the water, and we must show that they would not lose; finally, Colonel Jacob showed that the Delhi people would not lose, and I think that he has been justified in the result. On his strong recommendation very considerable extensions were made, *viz.*, the Nardak, Baiwani, Bhalot and Petwa Rajbahas. I would now myself like to continue that policy and push on the Western Jumna Canal. The canal has raised the spring level in the last 50 or 60 years and they can now work wells easily; my idea is that we should make them take to wells, revising the settlement if necessary; and that we should push on to Hissar, Rohtak and to those parts where the wells are very deep and which are no doubt the most unprotected part of the Punjab. Just referring to Mr. Wilson's memorandum might I bring it up to date in one particular. In the first paragraph he gives the irrigation figures for 1899-1900; the area irrigated by State canals in 1900-01 was 6,000,550 acres, that is, nearly 50 per cent. more than the previous year.

13. *Q.* Are inundation canals not included in State canals?- Yes, they are.

14. *Q.* In reducing the irrigation would you do it by reducing the size of the outlets?—No; we should do it by lengthening the *tatils* or periods of total closure.

15. *Q.* With regard to what you say in your note as to the development and improvement of the inundation canals, I think this is the most important subject we shall have in the Punjab?—That is practically the question on which Mr. Brodie gave evidence. I should like to put in these maps which show the hideous system of water-courses that at present exists.

16. *Q.* Of course what you propose entails a large expenditure of money—apart from the question of improvement of canals and better protection against famine; would these improvements be reproductive? —I think the probability is that they will be; I should of course be sorry to give any guarantee.

17. *Q.* You don't think there is any chance of their being hopelessly the reverse? No, there is no chance of that.

18 *Q.* Is it desirable to keep up a distinction between the grants given to these large inundation canals and those given for perennial canals?—It is not maintained as a matter of fact. We have two inundation canals the Lower Sohag and Para and the Sidhnai which were made as productive public works.

19. *Q.* There is no distinction so long as a work is productive, whether the work is inundation or perennial?—No. These two are eminently productive works.

20. *Q.* You make a reference to certain canals on which comparatively small sums have been spent and which have gradually been extended for a number of years?- Yes, we want money to improve them, but it does not matter where it comes from. I would treat them liberally, and even if they are not productive, I would put them on an efficient footing as protective works.

21. *Q.* Your paragraph 3 raises a thorny question which is not, I think, within our reference, I understand you to consider that the management of these inundation canals should be under the Irrigation Department as much as the management of the Chenab Canal?—Yes, and my reason is that at present on the inundation canals we are not in touch with the cultivators; if we were, we could no more to increase irrigation. If there is no objection, I should like to hand in this note by Sir Richard Strachey, dated 1867; I brought it to put in if the Commission will accept it.

22. *Q.* Now we come to paragraph 4; you advocate the construction of more weirs?—Speaking generally that whole question has been worked out; there has been a good deal said, particularly by the Revenue officers that the withdrawal of this water for our perennial canals would affect the *sailab* at the time of opening and closing the inundation canals. It must in fact do so. In noting on the Bahawalpur system of canals, I tried to show that the probability is that we might affect the opening of these canals by ten days at each end. I think it is possible. I think the cure for that is the heading up of low supplies in order to give early and late waterings. I think it would be a mistake to give perennial irrigation to these canals. Constant canal irrigation is injurious to *khadir* lands. If they get their waterings early, so as to be able to sow the *kharif* and late in the summer to mature it and put the *rabi* into the ground, they should depend then entirely on wells or rain to mature the latter crop. My view is, taking the Sutlej, that we might put a weir at Sobraon, and another at Fazilka, above which it would be quite possible to construct the Pak Pattan inundation canal; another weir might be put in at Adamwahan. It has not been worked out, but I believe it would pay to make these weirs from loan funds. The cultivators could pay higher rates when their supply was made more certain. If we gave them water *for kharif* and *rabi*, they should pay a higher rate than they pay on inundation canals.

23. *Q.* Would you try so to erect your weirs that there should be a canal system on both sides (referring to map)?—Yes, that is a *sine quâ non.*

24. *Q.* The Sobraon weir would not do for Bahawalpur?—No. (Explained on map.) I would not give any of these lands water in the *rabi*. The Khanwah Canal worked during the whole of the cold weather, but I think it is a mistake to let inundation canals run in the cold weather. What I have said as regards the Sutlej would apply also to the Chenab. (Explained on map.)

25. *Q.* Have you considered the navigation rights on these rivers?—We have not provided for them. I have referred to this matter in a recent letter to Government. It was really an oversight that no provision was made in the estimate for the Lower Bari Doab Canal for a lock in connection with the weir. As a matter of fact, we have not provided locks for any weirs except in connection with the Sidhnai Canal; if considered necessary, an addition of five lakhs to the Lower Bari Doab Canal estimate would more than do it.

26. *Q.* As regards the multiplication of weirs, I suppose you would agree that the cost of the weirs would be independent of the size of the canals?—The cost of the weir would be the same for a large or a small canal.

27. *Q.* With regard to what Mr. Wilson says in his note, dated 23rd October. "This is bad finance. If it can be shown (as it often can) that the expenditure of a lakh of rupees in extending or improving an inundation canal will bring in more than 10 per cent., that lakh should be immediately forthcoming; but it cannot be got, while there is no difficulty in getting lakhs of rupees for expenditure on a perennial canal" What is your opinion?- I agree generally, but of course we cannot do everything at once. Supposing the result of the labours of this Commission was that they said we will give an enormous sum for irrigation, still we could not spend it at once; we cannot work as railways do: that is, buy a million sleepers, or order so many hundreds of miles of railway track. Canals are made by coolies paid in pice, and there is a distinct limit to the amount that can be spent, certainly in the Punjab.

28. *Q.* The Financial Department would no doubt say so much the better?—Yes. There is, I think, a slight error at the end of the same paragraph. It is said that there is no capital account for the inundation canals; but, as a matter of fact, there is a capital account for the Lower Sohag, Sidhnai, Indus and Upper Sutlej Canals which are all inundation canals The Shahpur Canals are divided into Imperial and Provincial· there is a capital account for the Imperial portion. The only canals for which there are no capital accounts are the Muzaffargarh and Shahpur Provincial Up to this year, we had a capital account for the Lower Sutlej and Chenab Canals, but it was so small that we have closed it. This is shown in pages 10 to 13 of the Volume of Statistics, which accompanies the annual Irrigation Revenue Report.

29. *Q.* (*Mr. Ibbetson.*)—The Sidhnai and Sohag were made from loan funds and their capital account is complete?- -Yes.

30. *Q.* Of the other canals the capital account is not complete?- -It is quite complete for the Upper Sutlej Canals, all of which were made or purchased by Government; it is also quite complete for the Shahpur Imperial Canals which were made by Government, but in the case of the Indus Canals it is not a complete capital account.

31. *Q.* (*The President.*)—At the bottom of page 3 of the same note Mr. Wilson, says—" it is the duty of the State, when contemplating the construction of a perennial canal, to consider its effect upon the inhabitants of the river valley lower down, and to provide as far as possible for the maintenance of their

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present prosperity; one of the best means of doing this is to give them a share of the irrigation from the perennial canal." That I understand is the principle on which you work?—Yes, we will extend irrigation into the river valleys and reduce it as soon as the spring level rises; we have introduced this principle for the Chenab and Jhelum Canals this year, and the test will be the rise in the spring level; this is the only test that it is possible to have. Instructions have been drawn up and agreed to by the Civil and Revenue authorities and approved of by His Honour the Lieutenant-Governor. (Copy shown.)

32. *Q.* Is it looked upon as a duty to see that the existing rights are protected as regards the *khadir* lands; is there money compensation?—No, I don't think as far as I know that my department does anything except in the tracts where we have charge of the inundation canals, as, for instance, the tract between the Lower Sohag and Hajiwah.

33. *Q.* You recognize the principle so far that you have advocated that, in the event of the Lower Bari Doab Canal being executed, it is desirable to ensure the rights of early and late waterings, and it is to meet this case that you propose to put in weirs?—We have not recognized the principle in the past, but I consider it the right thing to do.

34. *Q.* Do you consider that supposing the sanction of the Government of India were given and funds were found that it would be desirable to go ahead with the Lower Bari Doab Canal at once?—Yes; I have advocated that we should go ahead with it this year.

35. *Q.* Mr. Wilson in his note says—"a new scheme like the Bari Doab project should not be sanctioned until a complete survey of the river valley below the proposed weir has been made, a thorough inquiry into the effect of the opening of the canal on the river valley below carried out, and provision made for remedying, as far as possible, the injury to the inhabitants of that valley to be anticipated as the effect of the opening of the canal." What do you think of that?—I think it would be very difficult to anticipate what will be the effect; as a matter of fact, we shall have to legislate for whatever happens when it does occur. It would be very difficult to anticipate what would be the effect of the opening of the new canal. I think I have shown that the opening of the Sirhind Canal has not affected the inundation canals of the Sutlej. The Revenue authorities do not agree. In any case we could not lower the beds of the inundation canals until the supply had been reduced in the river.

36. *Q.* You could commence with constructing the Weir?—I doubt whether we should be able to anticipate what it will be necessary to do.

37. *Q.* As regards the Lower Bari Doab Canal?—If injury would be caused, there would, no doubt, be a moral obligation on the part of the State to provide *pari passu* for those lands which would suffer by the new canals withdrawing the supply: I think this would be advisable from an administrative point of view. I would not, if it could be avoided, injure riverain land to irrigate high lands.

38. *Q.* Would you abstain from irrigating the high lands because it was injuring the riverain lands?—No, even if it were impossible to compensate them, I would still make a canal, because we should do greater benefit to the country as a whole.

39. *Q.* What would happen in such a case is, that the people would clear out of the *khadir* lands and go elsewhere?—I don't think that will occur.

40. *Q.* We had the other day strong pressure brought upon us to point out the necessity for a hydrographic survey of Dera Ismail Khan, with a view to putting on a more scientific basis the torrent irrigation in the Daman, and the witness also strongly advocated a large inundation canal like the Paharpur Canal for the country between the Daman and the river. Have you considered that question?—I know absolutely nothing about the torrent irrigation; I have never been in Dera Ismail Khan. The Imperial Government would not grant money for the survey of the canal because it was a doubtful project. The Provincial Government have only lately been able to furnish the funds. We have now formed a party to survey the canal (explained on map).

41. *Q.* Would you advocate what Mr. Wilson alludes to at the end of this note—"a complete survey, river by river, with a view to determining what can best be done to maintain existing cultivation, to restore abandoned cultivation and to provide facilities by means of inundation canals for the improvement or extension of cultivation?"—No, I do not agree. I think it is better to take the tracts bit by bit; it would be absolutely impossible to do it at once; we should have a great mass of information which we could not assimilate.

42. *Q.* Mr. Wilson's first proposition is an annual grant of 10 lakhs to the Punjab. Is that the kind of thing likely to meet your case or do you want more?—I doubt if we could spend more. Speaking roughly, I think 10 lakhs is an outside figure for the inundation canals.

43. *Q.* Coming back to the Western Jumna Canal, would it be, as far as you know, practicable, from an irrigation point of view, to take a great inundation canal, say from opposite Karnal right across down to Hissar?—I am afraid I could not give an opinion, as I do not know the levels. It is a question whether it is worth while taking only inundation irrigation into dry tracts. Mr. Ward and I have discussed this question (reference made to diagrams). You don't get a supply till well on towards the end of July, and it is gone by September; there is a working flood for a very short period only.

44. *Q.* Do you know how much of the low supply is utilised?—It is all utilised. The Jumna river is not a good river to take an inundation canal out of, because there would be insufficient water.

45. *Q.* The information we have received so far has been to the effect that the necessity for protection against famine is greater in Hissar than any other part of the Punjab, and that there is no way of meeting it?—No, except to withdraw water from Delhi and Karnal and give it there. I don't see any other way.

46. *Q.* If that policy were followed, it should be applied in all justice to both sides of the Jumna?—We should get into political negotiations with the North-Western Provinces which it would be better for the Imperial Government to adjust. Under the existing arrangement we take two-thirds and the North-Western Provinces one-third of the supply.

47. *Q.* Can anything on a large scale be done with the Ghaggar streams?—I doubt whether anything can be done. I am also personally very sceptical of the advantage of doing anything, because at the time you most want the water the rivers are dry. In a year of famine the absence of rain causes the channels to be dry; at the time you most want the water it is not there, and when the channels are full, the water is not wanted.

48. *Q.* It is no use, I suppose, trying to find if there are basins in the Himalayas in which water could be impounded at a reasonable cost?—The slope is too great; I know of no place. I doubt if you could make any storage works in the valleys of the Himalayas.

49. *Q.* (*Mr. Ibbetson.*)—Can you say anything of the hilly country within the Salt Range area from Jhelum to Rawal Pindi?—Note No. 19 on page 67 of my volume of notes deals with the subject. I believe there are valleys in which water could be impounded, but they are said to yield salt water.

50. *Q.* Has any examination ever been made?—I don't know.

51. *Q.* And about the Gurgaon hills?—There is a complete note in the "Notes on Irrigation Works." The general history is that they were in charge of our department up to the later seventies and then they were considered to be so small and insignificant that they were given back to the zamindars. There is a note on the subject at page 115.

52. *Q.* (*The President.*)—Can you supply us with any figures regarding the relative productiveness of irrigated and non-irrigated land?—No, I have none at hand. The difficulty is, I think, that the outturn varies from field to field. Some Settlement officers have made crop experiments and published the figures, but they are considered to be absolutely valueless owing to the difficulty of striking an average.

53. *Q.* What is your feeling about the necessity of artificial drainage in a properly irrigated tract like the Chenab where distributaries have been well laid out?—I think drainage must go hand in hand with irrigation. In this tract we have been particularly careful about reserving land for drainages.

54. *Q.* On *reh* and *usar* lands have you known satisfactory instances of remodelling canal distributaries in land which had gone into a state of deterioration?—No, I don't know of any.

55. *Q.* What about the Bari Doab Canal?—There is no *reh* land to speak of. We have perhaps a little more experience on this (the Chenab) canal; there is a great deal of *reh* on it, and our experience here has been that after five or six years of rice cultivation the land will bear a *rabi* crop.

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56. *Q.* Did you arrive at the conclusion that the rice crop sucked the *reh* out of the land?—I am not quite sure. The practical result was that it improved the land.

57. *Q.* What are your views of the Sind-Sagar project as far as you have got?—Please see page 70 and following of my volume on "The Punjab Irrigation Works."

58. *Q.* Are there great difficulties in the way of the Sind-Sagar project?—I think that my views have been exaggerated. I am very far from saying that the Sind-Sagar project is impossible. Since I rode into and have seen the *thal*, I would be extremely sorry to recommend the Government of India to survey the country in detail; it would cost five lakhs; a reconnaissance party is just going out in charge of Mr Ward to determine what tracts are likely to be worth irrigating; the Local Government will then be able to form an opinion as to whether the Government of India should embark on such a large project. There are large tracts that will not repay cultivation, partly on account of the sand-hills and partly on account of the poorness of the soil, but I have only ridden over 150 miles of the *thal*.

59. *Q.* (*Mr. Higham.*)—Have you got any cut and dried schemes for improving the inundation canals that are hung up for want of funds?—I don't think I can say that we have any hung up for want of funds. One in connection with Dera Ghazi Khan came up, but had to be returned a week ago to the local officers for further information with reference to financial prospects; that I contemplate sending to the Government of India; it is a scheme costing 5 lakhs and there are others in preparation. A good many schemes are in fair stages of advancement for submission relating to the Chenab Inundation Canals, Multan Division; some are being worked out; two came to me on Monday last; they are big schemes.

60. *Q.* Schemes for making distributaries, etc.?—Yes.

61. *Q.* I understand they have not got the levels of the country?—In this matter Major Morton could help you more than I could.

62. *Q.* And in Muzaffargarh?—We have no schemes ready.

63. *Q.* There are several proposals for new inundation canals in the *sailaba* tracts?—There are only two that I know of- one in Dera Ismail Khan, and the Pak Pattan scheme.

64. *Q.* Are there any proposals for inundation Canals from the Chenab for the *sailaba* between Khanki and the Jhelum?—None have been proposed since I have been in charge.

65. *Q.* With reference to the construction of weirs for these inundation canals, what do you estimate as the cost of the weir at Hariki?—75 to 80 lakhs of rupees.

66. *Q.* Does that include the whole of the head-works?—Yes, training works and everything.

67. *Q.* (*The President.*)—And canal head-works?—Not the canal regulator; that would go to the cost of the main line.

68. *Q.* (*Mr. Higham.*)—I suppose the weir, head channel, and regulator, etc., we may look upon as costing a crore of rupees?—Yes.

69. *Q.* And your three weirs would cost 3 crores of rupees?—Yes.

70. *Q.* Do you think that the works would pay?—I think so.

71. *Q.* Would they lead to an increase of area or increase of revenue?—To both.

72. *Q.* We could not get the benefit as regards canals in Native States?—Not, unless we carried out the work in connection with the States.

73. *Q.* Then you would make them contribute?—Yes.

74. *Q.* How long will it take to construct the weir at Hariki?—Five years.

75. *Q.* I suppose you could not construct any more weirs at the same time?—Yes, we could.

76. *Q.* It will take a number of years to make the four weirs?—Yes, no doubt.

77. *Q.* Then the inundation canals on the Sutlej will not be affected until the Lower Bari Doab is in full working order?—No, that will be in ten years; it would not, in my opinion, be possible to construct the Lower Bari Doab in less than that time.

78. *Q.* Could not meanwhile a great deal be done by improving the alignment of the distributary system on the inundation canals?—Unquestionably, that would go a long way towards meeting the case.

79. *Q.* I suppose weirs will have to be made eventually, but they would not have to be made until the irrigation on the Lower Bari Doab Canal is very fully developed?—I am not quite sure that it would not be remunerative to make the weirs at once. No improvements will be complete without the weirs.

80. *Q.* With regard to the Upper Sutlej Canals, they have paid very well in the last few years (statement shown). They worked for many years at a heavy loss, with occasional profit, but from the year 1888-89 there have been a steadily increasing area and increasing profits. It appears, looking at this paper, that the financial success of these canals dates from the opening of the Sirhind Canal?—It is coincident with it.

81. *Q.* Can any reason be given for the fact that the canals have improved since 1887?—The only reason that I can suggest is the general improvement in the administration of the Irrigation Branch.

82. *Q.* Has money been spent more freely since then?—I cannot say.

83. *Q.* Has money been spent on improving the Lower Sohag?—On all canals money has been spent in cutting off bends and making distributaries.

84. *Q.* It is clear from these figures that the Upper Sutlej has not suffered by the opening of the Sirhind Canal on which the irrigation has not fully developed until 1887-88?—Yes.

85. *Q.* I think you made several new distributaries on the Katora Canal?—Yes, all the canals were improved.

86. *Q.* My point is whether by improving the lower canals we cannot go a long way to counteracting the effect of taking off only 4,000 cusecs for the Lower Bari Doab Canal during the flood season?—I think very likely we can.

87. *Q.* That might be done before making weirs?—Yes, it will be all useful work.

88. *Q.* What has prevented it being done hitherto; simply want of funds?—Yes. We have never got the grants under Revenue heads that we have asked for; under loan funds we can get as much as ever we can spend.

89. *Q.* In regard to the proposal made by Mr. Wilson for carrying inundation canals to the high lands south of the Sutlej, Bikanir and Bahawalpur, would there be a great danger, if you had no *rabi* supply, of the canal being silted up?—It is an unquestionable danger; we should have to clear it.

90. *Q.* It would have to be cleared every year?—Yes. With a canal taking off above a weir we could not alter the position of the heads.

91. *Q.* Can you say whether levels permit of water being taken into the Lower Bari Doab from below the junction of the Chenab and Jhelum?—I can say positively that it could not. In 1893 I submitted a report on the subject which I shall send in.

92. *Q.* Can you say anything as to the feasibility of taking water from the Gugera Branch of the Chenab Canal into the Lower Bari Doab?—As regards levels, it is quite feasible, but it will be extremely expensive, because not only would you have to cross the Ravi river, but you would have to cross the whole valley of the Doh. The level of the water in the Gugera Branch is 675, and the level of the ground at Wan Radha Ram is 610, a fall of 65 feet in the level of the country. It is a little difficult to give the information exactly (reference made to contour map). As regards levels, there is nothing against it, but the scheme would work out to some prohibitive sum.

93. *Q.* If you carried enough water for irrigating the Lower Bari Doab, you would have to take it away from the Chenab Canal supply?—Presumably; if this were done, the water would not be passed into the Chenab Canal, but into a parallel canal which would be constructed. The canal could only run in *kharif* without interfering with the Chenab *rabi* supply.

94. *Q.* As regards affording protection to the district of Hissar, you say that the only course is to extend the Western Jumna Canal. That would be done by depriving the Delhi and Karnal districts of *rabi* watering?—It is the only way.

95. *Q.* That will mean not only depriving them of *rabi* cultivation, but also of sugarcane cultivation?—I don't think so necessarily. They can cultivate sugarcane from wells.

96. *Q.* That will increase the cost of cultivation?—No doubt.

97. *Q.* We would have to reduce the charge for water accordingly, if we only gave sugarcane watering in the *kharif*?—Yes.

98. *Q.* You would probably have to reduce the assessments on villages?—That is a revenue matter that would have to be faced.

99. *Q.* It is not a mere question of not allowing water for *rabi* crops; most of the villages depend on sugarcane cultivation?—Yes. The matter is now under the consideration of the Financial Commissioner as to whether we should largely enhance occupiers' rates on sugarcane.

100. *Q.* When the Sirsa Branch was projected and until some time after it was opened, it was never con- ated to give it a *rabi* supply at all?—I believe

101. *Q.* It was one of those canals in which a *kharif* supply only was to be run, as we could not increase the cold weather supply of the Jumna; what has happened in regard to that?—As far as I know it is treated exactly the same as the other branches of the canal.

102. *Q.* It is an instance of failure to satisfy a dry tract by giving merely a *kharif* supply?—Yes, it was found necessary to transfer *rabi* water from the old villages so as to give a supply to the Sirsa Branch.

103. *Q.* It is not denied that in the famine year the water in the Jumna was not sufficient to go round?—Yes, what there was, was better than none at all; but it is admitted that the canal irrigated crops were not up to the ordinary standard. On the other hand, prices were high.

104. *Q.* Are there instructions for the guidance of Canal Revenue officers for the prevention of water-logging?—Yes; these instructions came out from inquiries which the Government of India made with reference to the extensions of the Chenab Canal. Personally I think the principle is sound.

105. *Q.* You have done a great deal to restrict the irrigation on the Bari Doab Canal?—We have done something, but no restriction has actually yet taken place because the extensions have not been made.

106. *Q.* In the villages about Amritsar what percentage of the cultivable area is irrigated?—Some villages irrigated 100 to 120 per cent. I think, of the whole commanded area of the Bari Doab Canal, they are irrigation 68 per cent.; there are also large areas uncommanded. (Copy of a report on the subject promised.)

107. *Q.* My point is, Mr. Wilson says—"here where the rainfall is good canal water should be refused." Has any practical attempt been made to do that in villages of the Western Jumna and Bari Doab Canals where water is dangerously near the surface?—No, no systematic attempt has been made.

108. *Q.* Do you think that the operation of the *nahri parta* system tends to prevent the improvement of the irrigation?—Unquestionably it has done so.

109. *Q.* Has there been any withdrawal of irrigation and remission of the wet rate?—No. The figures show that the area has increased enormously. I have records in which I pointed out that the *nahri parta* ought to have been enhanced; we must have introduced new irrigation into a good many tracts and the wet assessment has not been put on, as it should have been.

110. *Q.* (*Mr. Ibbetson.*)—About the irrigation on the Western Jumna Canal, that substantially is of some 60 years' standing?—Yes.

111. *Q.* Before that there was considerable well irrigation?—I don't know if there was.

112. *Q.* An immense deal of harm had been done by over-irrigation during the first 30 or 40 years?—Yes, to certain tracts.

113. *Q.* To the greater part of the tract?—To the greater part of the tract then under command.

114. *Q.* Great injury was caused to the people and the soil; wells fell in and the whole tract became water-logged. Then you began to restrict irrigation and by that means you have done an immense deal of good?—Yes.

115. *Q.* Restriction took two forms; one was to restrict the amount of water to a given area and also the amount of the area to which water should be given, by limiting the supply?—I am not quite sure that there was any limitation of supply; the records show that since 1865 we have increased the supply entering the canal in both the *kharif* and *rabi*; you could not say there was a diminution.

116. *Q.* I mean the supply to an individual village?—No doubt.

117. *Q.* Did you introduce the system of allowing a village so many discharge outlets calculated in proportion to the area that you thought they ought to water?—I have no knowledge of it.

118. *Q.* Mr. Higham says you have doubled your area irrigated on the Western Jumna Canal in the last five years; you have not doubled your supply?—Very nearly.

119. *Q.* What is the average supply?—I put in a statement giving detailed figures.

120. *Q.* You have got to a point at which the supply is barely equal in a bad year to the irrigated area?—In the *kharif* it is quite equal.

121. *Q.* As a fact, in the last famine, the corps did suffer from short supply?—The *rabi* crops; I am not so sure that the *kharif* did.

122. *Q.* Now you propose to carry that procedure still further by taking water away from the old villages where wells can be built, in order to give it to villages and tracts where well irrigation is impossible?—Yes.

123. *Q.* Villagers would have to build wells or restore those that had fallen out of use in very large numbers in order to take the place of the water that you would take away from them?—Yes.

124. *Q.* You know sugarcane is an important crop in these parts?—Yes.

125. *Q.* The villagers practically pay their revenue from it?—Yes, I know they do.

126. *Q.* So important that it has been described by Colonel Ottley as the sheet anchor of the canal revenue?—Yes, that was his opinion; now-a-days we would not so describe it.

127. *Q.* I want to show its importance?—Yes, it is very important, it is going on still increasing; with reference to that, some Civil officers as well as Canal officers thought it would be a good thing to restrict it, in order to save water for fodder crops.

128. *Q.* I understand that that policy has been disallowed?—No. Sir Denis Fitzpatrick said sugarcane hampers us very much; the question of raising rates should be taken up; it was intended to raise rates in order to restrict it and set water free for *rabi* crops.

129. *Q.* I understood it had been definitely disapproved?—No, the matter is now before the Financial Commissioner.

130. *Q.* The present rate for sugarcane is extremely low?—Yes.

131. *Q.* It would require an enormous increase in the rate to reduce the cultivation of sugarcane materially?—Probably it would; I am very doubtful if any increase, which is in the least likely to be sanctioned, would materially affect the area.

132. *Q.* Do you think it would be possible that the number of wells, necessary to cultivate the same area of sugarcane that they now cultivate, could be built and the area maintained; I see that the area of sugarcane is 80,000 acres; if that were to be irrigated by wells, you would want at least 16,000 wells?—Probably more, perhaps 20,000, if it was to be transferred to well irrigation.

133. *Q.* Do you know any well-irrigated tract where the same proportion of sugarcane is cultivated?—I don't know any place, unless perhaps Batala.

134. *Q.* It is a fact that one of the first results of the introduction of canal irrigation is that the stock of cattle is decreased?—I have heard it is.

135. *Q.* And in other ways the whole agricultural economy of the village is modified; for instance, the Kumhars disappear and so on?—Yes.

136. *Q.* That is a strong argument, to say the least, against introducing measures such as you contemplate for restricting irrigation?—Certainly, still any extensions must be made very gradually.

137. *Q.* There is a good deal to be said on the other side of the question and against the proposal?—Yes.

138. *Q.* Do these considerations constitute a forcible argument against allowing irrigation on new canals to grow up to an extent which you are not prepared to maintain?—I have used it as such in the question of the Chenab extensions. I have also suggested that it might be right not to permit cultivators to irrigate a larger area than that for which we have promised to supply water.

139. *Q.* When a new canal is opened the tendency is to extend irrigation as fast as possible?—Yes.

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140. *Q*. But there are various weighty considerations on the other side such as I have referred to?—Yes.

141. *Q*. For instance, you say that in the *khadir* the irrigation has to be reduced as spring level rises?—Yes.

142. *Q*. Would it not be wiser to keep your irrigation down to the level which you contemplate may be safely allowed in *khadir* lands?—I am not sure that we can restrict it to that; the difficulty in working on the basis you suggest would be that we are unable to measure exactly the volume of the water supplied to each cultivator; we have nothing except the area irrigated as a fact and the spring level as a fact; of course the perfect solution would be the meter.

143. *Q*. In practice cannot you do it roughly by reducing your supply?—We do it, but there may be a difficulty on the large scale on which we should have to do it.

144. *Q*. Would it be a good thing to aim at?—Unquestionably.

145. *Q*. Have you any knowledge of any attempts to restrict the use of canal water on well-irrigated lands?—Yes, we tried our best to do that on the Bari Doab Canal; we used not to give water on well lands and tried to keep wells working.

146. *Q*. Did you succeed?—No.

147. *Q*. Why?—In the first place, at that time, there was a water advantage rate which was only charged to *barani* lands; as well lands had been assessed as *chahi*, we were not allowed to charge water advantage rate on such lands, so that a man who took water on well land paid less than on *barani* land.

148. *Q*. On some places you have charged double on lands irrigable by a well?—Yes.

149. *Q*. Did that stop the use of the water?—I am afraid I cannot say.

150. *Q*. Was it effective while it lasted?—I cannot say.

151. *Q*. In 1885 the North-Western Provinces made a similar attempt and failed?—I am not aware.

152. *Q*. Have you ever considered the question of varying rates for water, higher at the tail of the Bari Doab Canal for example and lower at the top?—I have considered and advocated it.

153. *Q*. Do you see any practical difficulties?—None. I think there might be a zone rate.

154. *Q*. Would the objection be that two villages on either side of the zone boundary would be paying different rates?—I don't think it would matter; that is the case under the land revenue system at present.

155. *Q*. You don't think any injustice would be felt, as between villages on opposite sides of your boundary line?—No.

156. *Q*. I understand that on any canal however scientifically laid out a certain amount of local damage will be done, which may be remedied by drainage—drainage to individual villages, to soil by water-logging, *reh*, etc.?—Yes.

157. *Q*. Has compensation within your knowledge been given to villages that have been damaged in that way by canals?—No.

158. *Q*. You advocate strongly the principle that individual interest must in some cases be sacrificed in order to secure the greatest benefit to the greatest number; is it not of the very highest importance that the individuals so sacrificed should be compensated and compensated amply?—Assuredly.

159. *Q*. Is that principle generally observed on canals in the Punjab?—I cannot recall any instances in which compensation has been given.

160. *Q*. I think in the Punjab to some extent, and in the North-Western Provinces to a very great extent, the mistake was made of beginning with too low water-rates and allowing landlords to acquire in the form of rent a very large proportion of the profits of water?—Yes.

161. *Q*. And that practically our attempts to recover a substantial share of that profit have failed?—Yes, they have failed, I believe.

162. *Q*. Recent policy in the Punjab canals has tended to impose full occupiers' rates so as to leave as far as possible no undue profits to the owners?—Yes.

163. *Q*. The necessary leniency which you must use on first opening a canal is met by fixing full rates and giving liberal remissions?—Yes.

164. *Q*. Does not the Local Government receive a share of water advantage rate, and none of occupiers' rate; and are not cesses levied on the former, but not on the latter?—Yes.

165. *Q*. Has not a water advantage rate been imposed where you think it would have been better to impose a higher occupiers' rate and no water advantage rate?—I know it has been continually urged by Settlement officers that if they didn't impose the latter they could get nothing out of the canal.

166. *Q*. Within your knowledge these two considerations have complicated the question?—Yes.

167. *Q*. In practice at present the Punjab Government has a much smaller interest in the extension and promotion of irrigation than the North-Western Provinces, the canals in the latter province having been provincialized and not those in the Punjab?—Yes.

168. *Q*. You are an advocate of provincializing the canals?—Yes, because I am a Punjabi and I think the Punjab should get the benefit of their splendid property.

169. *Q*. How far in the North-Western Provinces is the surplus income from the extension of irrigation secured to the Local Government, and how far is it absorbed in the quinquennial contracts. Having been in the Secretariat there, I suppose you know?—I don't think I can say exactly; the last contract is an extremely complicated one; I gave the details in the Revenue Report of the North-Western Provinces for 1898-99.

170. *Q*. Mr. Laville said the canal income is kept wholly outside the contract?—That is wrong.

171. Q. It is included in the contract?—Yes.

172. *Q*. That means that, apart from any agreement between the Provincial and Imperial Government, by which a larger proportion may be given to Provincial on account of good management, if the Provincial Government wishes to secure to itself a share of the increased income which it has gained, it must correspondingly increase its expenditure within the term of the contract?—It must do so.

173. *Q*. It is not always possible to spend the money year by year. Supposing it were possible to keep the canal income outside the contract and allow the Provincial Government to fund it on the understanding that it must be devoted to canal works, would that not be a powerful stimulus to extension of canal irrigation?—I don't think it would be easier than it is now.

174. *Q*. I understand you find it different to get money for minor works and surveys?—Yes.

175. *Q*. And then the improvements on inundation canals; would it not have been possible to carry these out if the Provincial Government had had an irrigation fund out of the income which it had earned from extensions?—Yes, if they had a fund like that.

176. *Q*. It would be a question between the Imperial and Provincial Governments; if the Provincial Government had such a fund at its disposal, would it not be a strong impetus to canal improvement?—Yes, no doubt.

177. *Q*. It is generally said that the indiscriminate use of water on lands for which there is not enough manure injures the soil. Is that your experience?—I cannot say that I see any deterioration of soil in the Punjab. I don't think the crops on the Bari Doab Canal are any worse now than they were 10 or 15 years ago.

178. *Q*. Not on the lighter soils?—No, I have not heard any complaints, though there has been heavy over-cropping. Taking also the Chenab, I cannot find that there has been any material deterioration.

179. *Q*. That is virgin soil. In any case have you noticed or heard of deterioration owing to the use of water where manure is not available?—No, in the Swat Valley they manure considerably.

180. *Q*. Do you think, as an Engineer, that if you were asked by a Punjab peasant to advise him as to the location of a well, which he intended to sink, that is to say, where he would be likely to come to a hard or a soft startum of soil, that you could give him any advice worth having?—No, not without boring.

181. *Q*. Do you think any Engineer in the Punjab could?—I don't know of any.

182. *Q*. Can you acquire that knowledge?—I don't think so without practical experience of sinking an enormous number of wells.

183. *Q*. Can you tell me the cost of a trial boring for a depth of say, 40 to 50 feet?—Something small, Rs. 10 to Rs. 15.

184. *Q.* The Famine Code projects of the Punjab have been just revised?—Yes.

185. *Q.* Were you consulted about them?—To a certain extent. All the projects suggested by the Executive Engineers came through me and were passed on to the Roads and Buildings Branch.

186. *Q.* Are there any irrigation projects included in them?—You can scarcely call them irrigation projects; there are cuts off from inundation canals, widening banks of canals, in one or two cases clearing escapes on the Western Jumna Canal. I think the projects will remain on the famine programme for the next 50 years.

187. *Q.* Supposing you were asked whether you could suggest any irrigation works which would be of value in exposed tracts, could you do so?—The only thing I could suggest would be the digging of the Lower Bari Doab Canal; that means of importing labour from famine tracts. I cannot suggest any irrigation works in any tract in which there is likely to be a famine.

188. *Q.* Do you know anything about the parts of the Punjab where *bunds* are possible?—No; the correspondence on the subject is printed.

139. *Q.* (*Mr. Rajaratna.*)—You suggest that the canal irrigation should be restricted in tracts where a large proportion of the area is irrigated?—Provided the water is wanted in other tracts.

190. *Q.* Otherwise you would not restrict it?—There is no particular object in doing so, unless you restrict in order to prevent or counteract the effect of water-logging. Otherwise I would let the people have it.

191. *Q.* Suppose there are ten villages which might be irrigated, though not liable to drought, would you still give them water?—I should like to distribute the benefits of irrigation fairly over the whole of the tract commanded.

192. *Q.* What is the object of giving it to a place not subject to drought?—It is best to give all a fair share of the prosperity.

193. *Q.* How would you restrict the supply?—By reducing the size of the outlets or reducing the time for which the water is supplied.

194. *Q.* In the case of *kharif* would you exclude a certain area from the benefit of irrigation?—I would not exclude a certain area. I would give every tract an equal share of irrigation.

195. *Q.* But the effect would be to reduce the quantity of each individual?—Yes.

196. *Q.* Would that not affect the outturn?—No; I don't think it would.

197. *Q.* If a field gets a smaller supply than before, won't that affect the produce?—It won't affect the gross produce.

198. *Q.* If I got less water won't my outturn be affected?—Yes, but somebody else will get the water.

199. *Q.* Still it would be at my expense. Do you think that would be fair?—Eminently fair.

200. *Q.* How?—You have paid nothing for it; you have invested nothing in the canal.

201. *Q.* I am paying the price of the water and I am not getting a proper outturn?—Then you should not be charged a water-rate.

202. *Q.* Supposing instead of an average crop of 12 annas I get only 8 annas, what relief would you give me?—In that particular case we should probably give you none; that is a point on which the Revenue Authorities are not quite at one; it raises the question of *kharaba* about which there has been a great deal of discussion, which is still going on; we have rules under which we give remissions in the case of total failure, but the rules don't allow for the case of reduction of outturn of crop.

203. *Q.* If you reduced the outturn by diminishing the supply?—Our rules don't provide for that.

204. *Q.* Should that not be taken into account when you propose a wholesale reduction?—I don't think the cultivator should be too grasping.

205. *Q.* Do pou propose to exclude a certain area from irrigation?—We have nothing to do with the area: suppose your share is 9 hours, you may do as you like with the water we give you; we cannot interfere with that; if we give you enough to irrigate 75 acres and you only put it on 60 acres, that is not our look out; we have no authority after the water leaves the outlet.

206. *Q.* It practically comes to this that by letting in a smaller supply of water to the rayat you compel him to reduce his area?—Yes, but we give it to the other than. We presume that whatever the rayat gets he will use to mature his crop and not spread it over too large an area and get an inferior crop.

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207. *Q.* By diminishing his supply you make it impossible for him to irrigate his crop effectively?—No doubt.

208. *Q.* You say on certain inundation canals water should not be supplied during the cold weather, what do you propose to do with the water so withdrawn? Do you propose to supply it to other places?—No, to let it go down the rivers.

209. *Q.* Why?—The *khadir* lands are better for not receiving it; the whole object is to protect the people against themselves and prevent water-logging.

210. *Q.* Are the rayats not the best judge of that?—No.

211. *Q.* You said that on the Ghaggar Canal people would not take water in certain seasons? No; on the Ghaggar Canals they would not take it in a year of heavy rainfall, because they don't want it; last year was a year of splendid floods, but the people did not require water.

212. *Q.* In ordinary years they would take it?—Yes, but in ordinary years we have not got the water.

213. *Q.* Have any experiments been made to determine the duty of water, to find out if the particular quantity of water allowed to a field affects the produce?—I cannot say. The Revenue Authorities have, I believe, made some experiments.

214. *Q.* You cannot tell if a particular canal is doing its full duty or not?—It is difficult to say what is the full duty. I don't think on any canals we have come to the maximum duty.

215. *Q.* Does not the question of outturn come into that?—I don t think we are in a position to test the outturn; the Settlement officers may have done it.

216. *Q.* (*Mr. Wilson.*)- Speaking generally, having regard to the inundation canals in the river valleys of the Punjab, has not much money been unprofitably spent, and could not the present area of irrigation have been attained by a smaller expenditure of money?—Yes.

217. *Q.* Can you say whose money has been wasted in this way?—I cannot say; in the old canals it was simply the labour of the cultivator.

218. *Q.* I don't refer so much to old canals as the canals of the last 50 years?—I cannot say.

219. *Q.* A great deal of money has been spent unprofitably there by private individuals or local bodies and not by Government?—I dare say.

220. *Q.* Could not a great deal have been saved if there had been a survey of the land and proper professional advice taken?—Unquestionably the canals would have been laid out on better lines.

221. *Q.* Is it not the case that the people were not in a position to get the survey done?—They could not have done it themselves.

222. *Q.* Is there not still a very large area in the river valleys that has not been surveyed by Government?—There are some areas but not very large; there are some areas on which we are working of which we have not complete surveys.

223. *Q.* We were told yesterday that a complete survey has not been made of the area irrigated by the Multan inundation canals?—No.

224. *Q.* You know something of the levels of the country in the Thal?—Yes.

225. *Q.* And the parts that are under survey in the river valleys of the Punjab would not take very long to survey?—No.

226. *Q.* You said the survey of the Sind-Sagar Thal would cost 5 lakhs?- That is a pure shot. I think the Lower Bari Doab was estimated for at 1¾ lakhs; it will be certainly more than three times that, probably 5 lakhs.

227. *Q.* Would that 5 lakhs not be ample to complete the survey of the river valleys of the Punjab?—Yes.

228. *Q.* Would it not be better spent than in a survey of the Thal?—At present we are going to make only a preliminary survey.

229. *Q.* If you had to decide on your present knowledge?—I would not at present advocate the detailed survey of the Thal at all; and I would take up the river valley survey bit by bit as we were ready to make a canal rather than complete the whole at once.

230. *Q.* The money would be more profitably spent than on the Thal according to your present views?—

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I cannot say; if the Sind-Sagar Canal is made, it might be more profitable to survey it.

231. *Q.* If you had a complete detailed survey of the river valleys, would you be in a position to say which project should first receive attention?—I think a detailed survey would only help us to make the canal; only the Civil officers could say which was the most promising.

232. *Q.* Would not the Civil officer be in a better position to judge if he had the levels?—No; I think it is a question of soil, sub-soil water, etc.

233. *Q.* When you have to prepare a scheme for a canal, is it not the first thing to make a detailed survey of the country?—Yes.

234. *Q.* Is not your knowledge of the advantages or disadvantages very vague until you have the levels?—Yes.

235. *Q.* Also as regards the advantage of making the canal at all?—It might be most advantageous to make the canal, but the levels will not help you to decide that; they help you to decide whether a canal is possible, not whether it is advantageous.

236. *Q.* What is the cost of the Lower Bari Doab scheme?—332¾ lakhs.

237. *Q.* What is the ultimate net profit on that sum?—It is at present estimated at 97 per cent.

238. *Q.* How long would it be before there was any net profit?—19 years.

239. *Q.* If you were told that in the next ten years you would be given a crore of rupees for inundation canals as soon as you could show that on any scheme Government would receive a net profit of 10 per cent., could you not work out a number of schemes that would give that promise, either in improving the existing canals or in other schemes?—Yes. But I would not like to be tied to 10 per cent.

240. *Q.* And the profit would come in immediately?—We should not have to wait so long as 19 years.

241. *Q.* Would not the increased return from improvements on inundation canals come in almost immediately?—Yes.

242. *Q.* Would it not be a more profitable financial transaction to spend a crore, if available, on such improvements which would bring in a net profit immediately than on a scheme which will only bring in 10 per cent. after a lapse of 19 years?—I am not sure; there are such a number of uncertain items. Small improvements on inundation canals would bring in a quick return, but what the return would be it is difficult to say; at present the rates on most of the inundation canals are so low that they do not promise well; on the inundation canals of the Indus we don't get more than Re. 1-8 an acre, on some canals we only get 6 annas an acre. This estimate of the Lower Bari Doab Canal is based on things that we know, water-rate and cost of maintenance.

213. *Q.* You mentioned that there were several schemes for improvement of inundation canals or the construction of new inundation canals ready?—Yes.

214. *Q.* If you were told that whatever money you wanted for survey in such tracts would be given at once and for whichever schemes you could send up which gave a promise of 5 per cent. net profit, could you not prepare a considerable number of such schemes very soon?—Yes.

245. *Q.* And the expenditure would be financially profitable to Government?—Unquestionably.

246. *Q.* Is there not a considerable complication in Shahpur because some of the canals are Provincial and some Imperial?—No, I think there is no complication because they are quite distinct; the Rahiwah is Provincial; the only other Provincial canals are two on the right bank of the Indus.

247. *Q.* I mean complication of accounts; you have to keep separate sets of accounts; it would be simpler to have them under one head?—Yes.

248. *Q.* You think it would be an advantage to the Province if all the Imperial canals were provincialized?—Yes; it is not so much a matter of accounts as that the Province should get a share of the benefits of irrigation, which it does not at present get.

249. *Q.* Do you think it is advisable to encourage the increase of private canals?—I am strongly against it.

250. *Q.* And of District Board Canals?—No, this is the age of specialists, and if you have a special department to do the work, it had better be done by that department.

251. *Q.* You think that new canals in the lower part of the Punjab should be under the control of the Irrigation Department?—Yes.

252. *Q.* Imperial or Provincial as the case might be?—I think that it is immaterial.

253. *Q.* Is it not the case that Government should consider themselves responsible for all development of irrigation all along the Punjab rivers?—Yes.

254. *Q.* Might it not be advisable, as in the case of canals, that the Irrigation Department should take some account of well irrigation and develope that also?—I am not quite sure that they are in the same category as canals because you are not going to administer a well.

255. *Q.* We have had it in evidence that the peasants are often in difficulties as to where to make a well and how best to make it; that help could be given by the use of boring tools and expert advice as to where they could best build their wells; could not officers of the Irrigation Department give them considerable help in the matter in future?—I don't think we have any very special knowledge as to the best sites; we could make borings or sink wells for them. I understood you referred to the administering of a well.

256. *Q.* No, only to give what help could be given through the Irrigation Department?—Yes, certainly.

257. *Q.* There is no other Department of Government that could do it so well?—No.

258. *Q.* Talking about the effect of weirs on the river levels below, you said that by deepening inundation canals you had counteracted any effect that the weirs had on reducing the level of the water?—Yes.

259. *Q.* Colonel Grey said that a large sum had been spent in Bahawalpur without any help from the Local Government. Has anything been done in the same way at the cost of Government to counteract the effect upon private inundation canals or private owners of land?—Not to my knowledge; on the rivers where we have weirs there are very few private canals; there is one in Multan; our weir has not begun to act there. I don't know if the Multan owner has done anything in the matter.

260. *Q.* So far nothing has been done to counteract the effect of the opening of canals on the land of private owners not irrigated by Government canals; anything that has been done was at the expense of the people?—I dare say. I have no knowledge

261. *Q.* About the use of the surplus water, is it the case that after the Jhelum Canal has been opened there will still be a certain surplus of cold weather supply in the joint Chenab and Jhelum?—Unquestionably.

262. *Q.* Would there be a surplus in the Jhelum?—Yes.

263. *Q.* How do you propose to utilize that surplus water in future?—Probably by the construction of a weir somewhere at the head of the Multan district to give early and late waterings to the Chenab series of inundation canals.

264. *Q.* Will that utilize the whole?—I cannot tell just now; I don't know what the volume will be. The Muzaffargarh Canals would be linked up. I don't know where else you could utilize it.

265. *Q.* Would it be a great advantage if you could supply the Sidhnai Canals from the Chenab?—Yes. The Sidhnai irrigation is precarious in some years.

266. *Q.* If you had a weir here which held up the cold weather supply, would that not give you a supply in the Sidhnai?—It would have to go back 12 miles (explained on map.)

267. *Q.* You said it would be difficult to take the Chenab across the Deg; could you not take it across the Ravi at less expense?—Yes.

268. *Q.* It is possible as regards levels, if there is spare water, to turn the Sirhind Canal into the Hissar district?—Yes, one great difficulty is the political difficulty of carrying water through Patiala.

269. *Q.* And also into the tract east of that?—Yes.

270. *Q.* (*Mr. Ibbetson.*)—Would water be available?—Not without restriction elsewhere.

271. *Q.* (*Mr. Wilson.*)—Is there not excessive irrigation in the Ludhiana district?—No; the percentage of irrigation is less than in Fazilka.

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272. *Q.* Is not well irrigation available?—Yes, Fazilka gets a much larger percentage; there we are irrigating 37 per cent. and up above not more than 25 to 28 per cent.

273. *Q.* You can at all events get a certain amount of water by taking it from tracts where well irrigation is possible?—Yes.

274. *Q.* Would that not be a better distribution of the water—a more widespread distribution of its benefit?—Yes, I think so.

275. *Q.* You spoke about the Ghaggar Canals in dry years drying up, and in wet years carrying water which nobody wanted. These are extremes?—Yes, but that covers every year of our experience.

276. *Q.* Is it not the case that the Ghaggar Canal gives you a better command of what water there is?—I doubt if it will ever be a valuable famine asset.

277. *Q.* In course of years you will be able to make better use of it, and it will no doubt be a considerable protection against famine?—Yes, whatever water there is will be made better use of.

278. *Q.* You have had some experience of counteracting water-logging. A good deal of advance has been made in several tracts?—Yes.

279. *Q.* It is not impossible to remedy water-logging?—No. In Karnal and parts of the Bari Doab a good deal has been done.

280. *Q.* On the Chenab Canal there are about half a dozen different rates; you are in favour of consolidating these rates?—Yes.

281. *Q.* You are in favour of differentiating the rates according to the qualities of the soil?—Yes, unquestionably.

282. *Q.* At present we have the same scale of occupiers' rates throughout the whole of the canal area?—Not quite.

283. *Q.* The occupiers' rate is a very low one for good soil?—I don't think so.

284. *Q.* The total demand is low?—Yes, it is low, I think, for the best soil.

285. *Q.* There are considerable blocks of land on which a higher rate is possible?—Yes.

286. *Q.* What is the effect of cultivation on poor soil and having a high rate for the use of water?—We are having difficulty in getting this poor land taken up.

287. *Q.* And the result will be that a considerable area of poor soil will not bear the cost of cultivation?—Yes.

288. *Q.* The value of water is greater on good land than poor land?—Yes.

289. *Q.* Is it not very advisable to first irrigate what good land is available and then afterwards to try as far as you can to reach the poor land?—Yes, certainly.

290. *Q.* You have quoted from a note written by Colonel Strachey in 1867. Is it not the case that in those days the management of the canals was in the hands of the Revenue officers; they managed the *chher;* they worked the canals and the Irrigation officer had no control on those inundation canals?—I think that he had the same control as he has now; it is a matter of history. The management is not now wholly in our hands.

291. *Q.* Not in Muzaffargarh?—We didn't get charge of them till 1880. In the Indus Canals I don't think there has been any difference.

292. *Q.* Is it the case that the management of these canals is entirely in the hands of the Irrigation officers?—We simply allow the water into the canal, but don't know where it goes.

293. *Q.* You manage the silt clearances?—But not the distribution of supply.

294. *Q.* What Colonel Strachey wanted to do has been done since 1867; is that not the case?—I am not aware that there is any difference. I think the canals would be more efficient if we were in touch with the cultivators.

Rai Bahadur Maya Das.

RAI BAHADUR MAYA DAS, Extra Assistant Commissioner, Ferozepore.

(Lahore, 8th November 1901.)

I.—Memo. by witness on inundation canals in the Ferozepore district.

(Not printed.)

Statement of progress on the 18 inundation canals of Ferozepore district abstracted from three statements which accompanied witness' memo.

	Acres.
Total area irrigated, 1875 to 1901	2,635,402
Area irrigated, 1891-92	121,397
" " 1892-93	168,056
" " 1893-94	138,949
" " 1894-95	128,557
" " 1895-96	56,107
" " 1896-97	84 537
" " 1897-98	162,914
" " 1898-99	151,247
" " 1899-1900	138,562
" " 1900-01	260,351

II.—Extract from a report by Rai Bahadur Maya Das, Extra Assistant Commissioner, in charge inundation canals, Ferozepore, to the Deputy Commissioner, Ferozepore, dated 2nd August 1901.

(Not printed.)

1. *Q.* (*The President.*)—You are Extra Assistant Commissioner in Ferozepore?—Yes.

2. *Q.* You have charge of the Ferozepore Inundation Canals?—Yes; I am one of the disciples of Colonel Grey.

3. *Q.* Were canals begun at that time?—I was Tahsildar when the canals were dug in 1875-76-77 under the supervision and guidance of Colonel Grey. I afterwards came to Lahore. When he returned from furlough I was placed in charge by special sanction of Government of India in April 1881. We started with 70,000 acres a year and now we have come to 3 lakhs a year.

4. *Q.* You say—"the only defect in the present system is fully discussed in my recent report?"—Yes, a copy of the report is attached to my memorandum. After writing my report one thing has occurred to me; I think it is a defect in irrigation; the people have taken so much to rice cultivation that it has deteriorated the land; we have even failed to discourage it by charging double rates. I would like to see this rice irrigation stopped first.

5. *Q.* You are unhappy about the prospects of these canals?—Yes, now I see there is a prospect of damming the river; the few canals above that point will be benefited, but those below it (a larger number) will

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suffer; we have already suffered on account of the Sirhind Canal; we lose 15 days at the beginning and 15 days at the end. I think it most essential that these canals should not suffer.

6. *Q*. What is the Mamdot Estate?—It is an estate under the Court of Wards—a belt of land, 10 miles long and 35 miles broad. We treat Mamdot just like any other body of irrigators, *i.e.*, they pay the *bachh* or establishment rate and do their quota of silt clearance, etc., according to the irrigated acreage.

7. *Q*. What is the arrangement on these canals?—Suppose a man has irrigated 10 acres, and on his land the silt deposited is 20 cubic feet, we distribute the cubical contents of the silt on the area irrigated; we tell each zamindar so much of your area has been irrigated, accordingly you have to dig so much silt and similarly we distribute the expenses of the establishment on the area irrigated.

8. *Q*. Is the silt clearance done by the people themselves; is it *chher?*—We call it *dak bandi*. I condemn the use of the word *chher*. *Chher* means that a certain number of men assist in doing joint work. Our system is to allot a fixed task to each. If a man fails he pays double.

9. *Q*. If a man did not wish to dig and said here is Rs. 20 instead; would you take it?—Yes. Now-a-days a man often does that. We do not charge him double if he pays at once.

10. *Q*. What is the establishment?—I am at the head; acting as Superintendent, I have general control over both canals and Mamdot. I have an overseer also besides the Assistant Superintendent and the Canal Tahsildar.

11. *Q*. Now your system was begun in very exceptional circumstances; Colonel Grey devoted a great deal of time to it and so have you. Could you reproduce a system like that elsewhere?—No.

12. *Q*. What does a man pay you for his water?—He pays only the cost of the extra establishment at about four annas per acre.

13. *Q*. (*Mr. Rajaratna.*)—With regard to what you say as to the discouragement of paddy, what is your rate for paddy?—Government charges Re. 0-12 per acre. I charge about Rs. 1-8, *i.e.*, double charge including the establishment rate and silt clearance.

14. *Q*. Why do you wish to discourage rice cultivation?—Because I think it not only deteriorates the land, but it deteriorates the men. We Punjabis are *chappatimunchers* and have always been soldiers. If we take to eating soft rice, our hearts also will become soft.

15. *Q*. Does your paddy require constant irrigation?—Yes, at least for three months, the thing is a loss, as very often it is not half ripe by the time our canals stop; it is only green fodder and this the people cut down and sell in the bazar.

16. *Q*. What is the proportion of the outturn as compared with other crops?—It varies; if it is a good crop, it may be worth Rs. 50 an acre; if it is bad, it is not worth fifty annas; for *chari* or *juár* a man will get Rs. 25 an acre, but that will be sure.

17. *Q*. If you have no remission for failure of rice crop, will that check it?—Giving no remission would check it. This cultivation is a great temptation to the zamindar; if his rice crop fails, he sells the fodder, ploughs up the ground, and sows gram which produces Rs. 15 an acre; and as there is no charge of any kind on such crop, the zamindar is tempted to run the risk, *i.e.*, if the rice crop is matured, as it sometimes is, then he gets his Rs. 40 to Rs. 50 per acre; and if it fails, the cultivator utilizes the green rice as fodder and cultivates *rabi* on the same moisture with the help of well irrigation and has nothing to pay.

Mr. J. Wilson.

Hon'ble Mr. J. Wilson, C.S.I., Settlement Commissioner, Punjab.

(*22nd October 1901.*)

(1) *Note on the means of irrigation of the Lower Bari Doab.*

The rivers of the Punjab after they debouch from the Himalayas on to the great alluvial plain of Northern India, all bend to the westward. This general trend is possibly due to the effect of the rotation of the earth from west to east. At all events it has been going on for centuries, and there is ample evidence from the records of the past fifty years that the westward tendency is still in full force. One result of this action is that the rivers have left behind them on their south-east bank wide valleys of comparatively low level, the result of recent alluvial deposits in the abandoned river-channels, and that they are cutting into comparatively high land on their right or north-western bank, so that it is generally easier and less expensive to conduct the water of a river for purposes of irrigation on to the land on the left bank than on the right bank. Another result is that the Indus, the most western of the Punjab rivers, keeps closely to the Sulaiman Range, which bounds the Punjab on the west, and is separated from it by comparatively high-level alluvial land, formed by the *detritus* from that Range; so that there is very little land to the west of the Indus which can be irrigated by canals from that river. The only use therefore that can be made on a large scale, for irrigation purposes, of the water of the Indus, is to irrigate by its means the Sind-Sagar Doab tract lying to the east, and there is ample water in the Indus alone to irrigate all that is irrigable of that Doab. Similarly, the Jhelum river cannot be used to any extent to irrigate the comparatively high land on its right bank, and it is now being utilized to irrigate the Jach Doab lying on its left bank, and will furnish an ample supply for the irrigation of that Doab. The Chenab again has been similarly utilized to irrigate the Rachna Doab lying on its left bank and will supply sufficient water to irrigate the whole of that area. The Ravi also now irrigates the upper portion of the Bari Doab on its left bank, but it does not furnish a sufficient supply of water for the irrigation of the lower portion of that Doab. Similarly, the Sutlej by means of the Sirhind Canal irrigates a portion of the vast dry tract south and east of its valley, and there is a considerable area of irrigation from that river on the same side by means of inundation canals in Ferozepore and Bahawalpur, while the canal irrigation on its right bank is comparatively insignificant.

There is still a large surplus supply of water in the Sutlej, especially after its junction with the Beas, for a further great development of irrigation, and in accordance with the system hitherto pursued in dealing with these rivers this supply should be utilized in extending irrigation to the desert country to the south-east, where there is a vast area of good soil available for cultivation. But, contrary to the general rule above described, it is now proposed to utilize this water in irrigating the Lower Bari Doab on the *right* bank of the river, *against* what may be called the general slope of the country. This will not only deprive the desert country to the south of any chance of future irrigation on a large scale; but will leave unutilized the surplus waters of the Chenab and Jhelum. These rivers will, after supplying ample irrigation to the Jach and Rachna Doabs, still have a large surplus of water available, which cannot be used to irrigate the comparatively high land of the Sind-Sagar Doab Thal and must run to waste unless it is employed to irrigate the Lower Bari Doab. In order to do this it must be carried across the Ravi, but this can present no great engineering difficulty, as the Ravi is not a large river; its channel is often dry in the winter, and it would be easy to control its floods in summer (reduced by the amount taken into the Bari Doab Canal) by a weir which would divert them into the canal crossing the valley from the Chenab, or pass them on down its own channel. Even a high-level aqueduct across the Ravi would not be impossible. This would leave the whole of the water of the combined Sutlej and Beas available for the irrigation of the great tract to the south-east, which must otherwise remain for ever a desert.

I recommend therefore that an inquiry be undertaken as to the feasibility of constructing a weir across the Chenab river below its junction with the Jhelum and taking out a canal from that point across the Ravi Valley to irrigate the lower portion of the Bari Doab in the Mooltan district; and that the expensive Lower Bari Doab project of a canal from the Sutlej be held in abeyance until this scheme has been examined.

It might also be found possible, at some future time, to extend the eastern branch of the present Chenab Canal across the Ravi higher up to irrigate that portion of the Bari Doab which lies in the Montgomery district.

Mr. J. Wilson.

II.—Note on the Irrigation of the River Valleys of the Punjab.

When the Punjab came under British rule, half a century ago, the only canals of any importance in existence were (with the exception of the Western Jumna Canals which is outside the Punjab proper) the inundation canals in the extreme south-west of the Province which had been drawn from the rivers Sutlej, Chenab and Indus to irrigate the comparatively low land in the valleys of those rivers. The annual rainfall rapidly decreases as the distance from the Himalayas to the south-west increases, and soon a zone is reached below which cultivation by means of the local rainfall only becomes extremely precarious. Accordingly cultivation was then, in that part of the Province, confined almost entirely to the valleys of the rivers, where it could be carried on by means of the river-floods, of these small inundation canals, or of wells. The population also was to a great extent confined to the neighbourhood of the rivers, while the doabs or high-lying alluvial tracts between the rivers maintained only a very scanty population who subsisted mainly on the produce of their flocks and herds.

The inundation canals had been for the most part excavated by the irrigators themselves under the encouragement of the local rules, and were annually cleared by the labour of the irrigators, organised by the ruler of the day. When first the British Government took over the country it failed to realise the need of aiding the people to maintain these canals, which began to fall into disrepair; and it was only after irrigation and cultivation had fallen off considerably that the necessity of Government interference was realised, and the management of these canals was taken over, first by the Deputy Commissioner and afterwards by the Irrigation Department. The clearances continued to be done by the irrigators with their own labour, but it was organised by the officers of Government. As the canals had been constructed and were maintained by the irrigators and not at the direct expense of the State, they were looked upon not as State canals, from which the State could draw any direct profit, but as in a sense owned by the people themselves. No charge was made by Government for the use of the water; and as no direct income was received by the State from these canals, Government was very reluctant to expend any money on their extension or improvement. Their management has been greatly improved in the last thirty years under the control of the officers of the Irrigation Department, but it has always been difficult to obtain money to spend on them, and many obviously desirable improvements have remained in abeyance for that reason.

Arrangements are now in progress for abolishing the old system of having the canals cleared by the irrigators themselves, and for introducing what is now almost the universal system elsewhere (except on Ferozepore) of having the canals cleared and maintained entirely at the expense of the State, which will derive an income from cash rates levied from the irrigators for the use of the water (occupiers' rates). The change of system is now being carried out in the Mooltan district under the orders of the Government of India and proposals have been submitted for effecting a similar change in the Muzaffargarh district. The new occupiers' rates have been fixed at a low pitch, in the first instance, chiefly because the rent system of the country had become established on the basis of the custom that the tenant should supply the labour required for the annual clearance of the canals, and to have suddenly charged occupiers' rates appreciably higher than the cost of this labour would have disturbed the established system of rents, and the whole relations between landlord and tenant. The rates charged have therefore been calculated so as to merely cover the actual cost of annual clearance and maintenance of the canals, and there will be no immediate direct profit to Government from them.

It has been decided by the Government of India that in the case of these inundation canals the usual principle should be acted upon that the occupiers' rates should be periodically re-examined, and if deemed advisable, enhanced with the object of securing, as far as possible, a fair value for canal water; and that future administrations should not be in any way debarred from taking whatever rates may be considered by them to be fair and recoverable without oppression from the occupiers. It is, however, to be hoped that the rates now fixed will not be raised for some time to come, as the change now introduced is one which will radically alter the system of canal and revenue administration, and as any considerable enhancement of the rates would further disturb the relations between landlords and tenants, and possibly require a reconsideration of the land revenue assessment.

Secretary to the Government of India, Public Works Department, No. 321, dated 7th February 1893

In the meantime these canals will bring in practically no direct profit to the State. The advantage derived by the State from them is represented by the land revenue charged on the cultivation which is made possible by their maintenance, and an indirect credit of land revenue is allowed to the canals on this account. Should the canals be neglected, the income of the State from land revenue will fall off. Should they be improved and extended, the land revenue will, under the system of fluctuating assessment now generally introduced on these canals, be enhanced. It is therefore to the pecuniary profit of the State that it should expend money on extending and improving these canals, although the accounts of the Irrigation Department may not show a direct profit from the expenditure.

There is still a difficulty in obtaining money to expend on improving these canals. In recent correspondence which arose from a remark of the Deputy Commissioner, Dera Ghazi Khan, who reported that the area irrigated from the inundation canals in his district had fallen in four or five years from 200,000 to below 170,000 acres, and that the people considered this to be due to want of attention and insufficient expenditure on the part of Irrigation Department, the Chief Engineer explained the existing system as follows:—

"Funds for the extension, improvement and maintenance of the canals and embankments are all included in budget head 43—Imperial Minor Works and Navigation." No distinction is made by the Government of India between capital and revenue; a lump sum grant is made for the working of the Imperial canals under this head as funds can be spared from the general revenues of the country, and it is distributed by me amongst the various canals and to capital works or maintenance as seems advisable in the general interests of the whole canals in the Province."

This is bad finance. If it can be shown (as it often can) that the expenditure of a lakh of rupees in extending or improving an inundation canal will bring in an increased net income to the State (whether in the form of occupiers' rates or land revenue) of more than 10 per cent., that lakh should be immediately forthcoming; but it cannot be got, while there is no difficulty in getting lakhs of rupees for expenditure on an extension of a perennial canal. Apparently the reason is that no Capital Account is kept for these inundation canals, and this prevents the Government of India from seeing that it is as much a profitable expenditure of capital in the one case as in the other. I trust that something can be done to make capital funds readily available for all extensions and improvements of these and other inundation canals which can be shown to be a profitable investment of State capital, whatever be the form in which the expenditure and income be shown in the public accounts. The remedy seems to be to allot every year from Loan Capital a substantial sum, say, ten lakhs of rupees, to be expended on construction, extension and improvement of inundation canals. If, in order to attain this end, it is necessary to open a Capital Account for such canals, this should be done.

But there are other than merely financial considerations which render it incumbent on Government to devote more attention to the maintenance of irrigation in the river valleys. In the early days of British rule it was soon seen that the resources of the Province could be greatly improved by drawing water from the rivers and spreading it over the thirsty land. District officers made spasmodic attempts to arrange the construction of inundation canals, and in many cases these were highly successful. Usually they were constructed, in the first instance, at the cost of individuals or local bodies, and it was only after they had proved a financial success that Government stepped in and took them over; and even now that some of them for which Capital Accounts are kept, show a net profit of over 20 per cent. per annum, it is difficult to get money to expend on their improvement or on the construction of similar canals elsewhere. The money and the engineering skill at the disposal of the State have been to a large extent monopolised by the great schemes for the construction of the perennial canals which have proved so great a financial success and so great a boon to the country. These canals have made

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it possible and highly profitable to cultivate the great arid tracts which formerly were only very sparsely inhabited, and which now support a large and prosperous population. But this has been done largely at the expense of the inhabitants of the river valleys, where the population of the South-West Punjab was formerly concentrated. The abstraction of a large proportion of the water from the rivers on which they were dependent has affected injuriously the working of the inundation canals, the spread of the river-floods and the level of their wells, and thereby has directly impaired the means of irrigation available to them. The pasture lands to which they used to send their cattle have been occupied by alien colonists. Their tenants and labourers have been attracted away to the more easily cultivated canal lands, and their villages are deserted, their wells are abandoned, and their cultivated lands lie waste. It is true that the general prosperity of the country has been enormously enhanced, and that many of the individuals who have irrigated from the river valleys to the canal-irrigated uplands have improved their condition. But they have in many cases only been driven to migrate by the gradual impoverishment of their villages, due directly to the action of the State, and those of them who have clung to their old homes have seen their old prosperity wane, while their more fortunate fellows on the perennial canals have waxed fat. More especially the owners of the land have seen their tenants leave them, their rents decrease, and their income from their lands rapidly diminish. Some relief has been tardily given them by a reduction of the land revenue or by introducing a system of assessment fluctuating with the area of matured crop; but it is poor consolation to a man who used to get annually Rs. 60 net profit from his well and pay Rs. 20 of this as land revenue to the State, when he sees his well abandoned, to be relieved of the payment of Rs. 20 due to the State, and to be left without the surplus of Rs. 40 which helped to support himself and his family; or to a peasant who finds it no longer possible to cultivate his holding, owing to the failure of an inundation canal, to be told that he need no longer pay the land revenue due on fields that produce him absolutely nothing. Some compensation has been made to the owners of land on the Ravi and Chenab for the injury done them by the opening of the perennial canals by giving them grants of land on the Chenab Canal, but such grants can be given only to a small percentage of the sufferers, and most of them remain uncompensated.

What I would urge is that it is the duty of the State, when contemplating the construction of a perennial canal, to consider its effect upon the inhabitants of the river valley lower down, and to provide, so far as possible, for the maintenance of their present prosperity. One of the best means of doing this is to give them, in their existing villages, a share of the irrigation from the perennial canal, and I am glad to see that this principle has now been adopted by Government, and that irrigation from perennial canals is to be extended as far as possible into the river valleys, due precautions being taken to prevent water-logging. Another means is to provide new heads for existing inundation canals higher up the river, so that the present command may be maintained when the total supply in the river is diminished by the opening of the perennial canal. Existing inundation canals should also be extended and improved, and new inundation canals made to provide means of irrigation to village lands, and enable the owners to keep their wells going. A new scheme like the Lower Bari Doab project should not be sanctioned until a complete survey of the river valley below the proposed weir has been made, a thorough inquiry into the effect of the opening of the canal on the river valley lower down carried out, and provision made for remedying so far as possible the injury to the inhabitants of that valley to be anticipated as the effect of the opening of the canal. In the case of canals already constructed a similar inquiry should now be instituted and all possible remedies applied, the cost being added to the capital cost of the canal.

Chief Engineer's Note No. XXIV, dated 20th June 1901, page 81 of Notes.

I anticipate that the process now going on will continue to develop, and that by degrees a great portion of the waters of the Punjab rivers will be diverted by successive weirs on to the Doab uplands; but there is no good reason why the cultivation of the river valleys should be abandoned, and there will always be a large surplus of water in the flood season which will not be required by the perennial canals and which could be utilised by means of inundation canals for the irrigation of the low-lying lands near the river-beds, which it would not be convenient or advisable to irrigate from the high-level perennial canals. The construction of inundation canals should therefore be continued alongside that of perennial canals. It will still be in many cases financially profitable to the State, but even where it cannot be shown to be so, it may often be advisable to make such a canal in order to treat with justice the river-side population. I believe, however, that there are many tracts in which inundation canals can still be constructed which will bring in a substantial direct return on their capital cost. Nothing has yet been done in the Indus river valley in the Dera Ismail Khan district, though the neighbouring district of Muzaffargarh is well supplied with inundation canals. Hardly anything has been done in Jhang district, though inundation canals have been worked with great success in the Shahpur district above it and the Mooltan district below it.

My recommendations are that a due proportion of the capital and engineering skill at the disposal of the State should be expended on the improvement of the means of irrigation in the river valleys, and more particularly that—

(1) a grant of ten lakhs of rupees should be made annually from Loan Capital for the construction, extension and improvement of inundation canals, apart from the amount required for the maintenance of the existing irrigation; and that additional funds be made readily available for capital expenditure on such canals if required;

(2) a complete survey should at once be undertaken of all the river valleys of the Punjab river by river, with the view of determining what can best be done to maintain existing cultivation, to restore abandoned cultivation, and to provide facilities by means of inundation canals for the improvement or extension of cultivation;

(3) the Sind Sagar Doab Canal be left to a future generation;

(4) the Lower Bari Doab Canal project be held in abeyance until the inquiry now advocated has been completed.

III.—Note on future Irrigation Policy in the Punjab.

The following statement will give some idea of the development of irrigation in the Punjab since 1868. Detailed figures are not available for an earlier date. I give the figures in thousands of acres :—

Period.	Total cultivated area.	Total area irrigated.	Area irrigated by State canals.
1868	20,168	5,984	1,125
1899-1900 . . .	27,896	9,376	4,244

Thus, while the cultivated area has in the 33 years increased by 38 per cent., the irrigated area has increased by 56 per cent., and the area irrigated by State canals has quadrupled. One-third of the cultivated area is protected by irrigation.

Figures have been separately given showing the rapid development of the State canals. It is to be noted also that wells are still one of the most important means of irrigation, the area irrigated from them during the last year having been 4,155,000 acres, or just short of the 4,244,000 acres irrigated by State canals. Irrigation from wells continues to develop steadily as will be seen from the figures for the last ten years :—

Year.	Wells fit for use in thousands.	Area of crops matured by well irrigation, thousands of acres.
1890-91	263	3,822
1891-92	273	3,696
1892-93	271	3.429
1893-94	279	3.450
1894-95	278	3,072
1895-96	287	3.731
1896-97	306	4,007
1897-98	302	3,971
1898-99	309	3.957
1899-1900	349	4,155

It will be seen that although, as might be expected, an impetus was given to well-sinking and well irrigation in the dry years 1896-97 and 1899-1900, the progress has been on the whole remarkably steady, and there were last year in the Province 86,000 more wells fit for use than there were ten years before. There has been a larger proportionate increase in *kachcha* than in masonry wells. As the former cost little and are more easily sunk than masonry wells in a sudden drought, the number of such *kachcha* wells in use last year was 31,000 more than in the year before. But masonry wells also show a steady increase, the number so classed having increased from 222,000 in 1889-90 to 275,000 in 1899-1900, or by 53,000. The cost of a masonry well varies very much according to the depth to water and the character of the masonry, but it must average at least Rs 300; so that in the last ten years the people of the Punjab must have spent about Rs. 1,59,00,000, or, say, a million sterling in the construction of new wells or the repair of old ones, besides what they spent in maintaining the other 200,000 or more in working order. This means a capital expenditure on masonry wells alone of an average of sixteen lakhs per annum.

(See printed statement.)

Let us now see that help has been given by Government towards this great development of well irrigation, from which it benefits so much directly and indirectly. From a statement I have had made out from the Annual Revenue Report it appears that during the last eight years the total sum advanced under the Land Improvement Act was Rs. 21,10,267. More than half of this must have been advanced to colonists on the Chenab Canal to enable them to pay the preliminary expenses of survey, water-course construction, etc. And the actual amount advanced for well construction cannot have much exceeded one lakh a year, against the sixteen lakhs a year spent by the people on construction of wells. Moreover, in those eight years the total amount of principle outstanding under this Act has been reduced from Rs. 15,19,472 to Rs. 13,49,368. Only Rs. 6,639 have been written off as irrecoverable and the total amount realised as interest is Rs. 7,84,487, so that apparently the revenue account stands as follows:—

Statement XXVI.

	Rs.
Interest recovered in the 8 years .	. 7,84,487
Sums written off as irrecoverable .	6,639
Net income	. 7,77,848

or an average of Rs. 97,231 per annum, which gives a percentage of over 7 per cent. on the average outstandings of Rs. 13,46,777. As the Local Government pays only 3¼ per cent. to the Government of India on sums borrowed to be advanced under this Act, it makes a handsome direct profit out of its money-lending business under this head, besides the great indirect advantages it derives from the extension of well irrigation. According to the account furnished by the Assistant Secretary to Government, Financial Department, the net gain to the Provincial Government from these loans has been Rs. 40,000 per annum on the average of the last eleven years. The encouragement given by these advances is not, however, so far of any great importance. From Statement XXVII attached to the Annual Land Revenue Report it appears that during the last ten years only 3,132 new wells were made and 289 old ones repaired with the aid of advances under the Land Improvement Act, while, as already said, the landowners in that period constructed or brought into use 53,000 masonry wells, or 15 times as many as were aided by the State.

The process of granting advances under the Land Improvement Loans Act has been considerably simplified of late, but the accounts are still very complicated. Interest is charged at 6¼ per cent., and it is thought necessary to keep an elaborate account of repayments of principle and interest separately for each instalment which confuses the borrower and causes extra labour to the officials concerned. This is one cause of the unpopularity of Land Improvement Loans; other causes are the difficulty in getting a loan which is sometimes caused by the smallness of the grant made available year by year for the Province, and the levy of 6¼ per cent. interest, which, though low as compared with the rates actually charged by private money-lenders, sounds high to the borrower when he is told he will have to repay double the amount borrowed if the instalments are spread over 20 years. I would invite attention to the calculation made by Colonel Grey, in which he shows that if Rs. 300 lent as a *takavi* advance to make a well be recorded *without interest* by annual instalments of Rs. 30, the actual cost of the loan to the State is only Rs. 101-6-0 and as after the expiry of the period of repayment the State can realise an extra land-revenue of Rs. 20 from the well for ever, its advance, though made without interest, really pays it 20 per cent. on its capital outlay. In the adjoining Multan district the average fixed assessment imposed on a well at the recent settlement is Rs. 20, but besides this the construction of a well, which enables the cultivator to bring to maturity a much larger area of canal irrigated crops adds greatly to the land revenue realised under the system now introduced under which the land revenue on canal-irrigated crops will vary with the area of crop matured and will be levied in addition to the fixed assessment on the well. Similarly, the well will add to the amount of occupier's rate realised, as that is levied on the matured crop area. In the canal-irrigated tracts of Multan a well can be made for Rs. 300; and if such a well be constructed by means of an advance made without interest on Colonel Grey's scheme, the State will ultimately, after the expiry of the periods for the repayment of the loan and for the protective lease, *i.e.*, at the latest after twenty years, gain a net profit of much more than 20 per cent. on the actual capital cost of the loan. In a district under fixed assessment the return to the State must be deferred till the expiry of the period of settlement, or at the outside 30 years, but the State can well afford to wait even this period in order to get a return of more than 20 per cent. on its capital expenditure, more especially when it is considered that every well constructed adds to the produce of the country, the security of the land revenue, and the protection of the population from drought and famine. It would therefore be a profitable financial speculation for Government to advance without interest very large sums for the construction of wells wherever they are likely to ultimately add much to the canal or land revenue, as they will all over the plains of the Punjab. I would urge that this policy be generally adopted, and that ten lakhs of rupees be placed annually at the disposal of the Punjab Government for advances without interest for the construction of wells. These advances should be kept distinctly separate in the accounts from other loans and it should be realised in the Provincial contract and elsewhere that they will on the average bring in no net profit for about 15 years, but will then give a profit of more than 20 per cent. on the net outlay. If this be thought too bold a policy, I would ask that at least the rate of interest charged on such advances should be reduced to 4 per cent., so that Government should not make any direct profit as a money-lender, in addition to the great indirect benefits it derives from the construction of wells.

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Settlement Report, paragraph 34.

Notwithstanding the great progress that has been made in the last fifty years, I consider that irrigation in the Punjab is but in its infancy. We are only beginning to tap the sources of water-supply, above and below ground. Our great perennial canals, though they absorb almost the whole of the winter supply in some of the rivers, utilise only a fraction of the monsoon supply, and the summer floods pass on to the sea in practically undiminished volume. Meanwhile there is any amount of land available for irrigation. The area of unirrigated cultivated land in the Punjab is some 15 millions of acres, and the total cultivable uncultivated area is over 21 millions of acres, making a total of 36 millions of acres. Of this area at least 20 millions of acres are commanded by the rivers as they issue from the hills, and it is quite possible to add this to the 9 millions of acres already irrigated by canals and wells. Moreover, there are further untold millions of acres in the Rajputana desert which it is quite feasible to irrigate from the Punjab rivers. I anticipate a time when the flood waters of these rivers will be poured over vast tracts to the south and east, giving them sufficient moisture for the ripening of an autumn crop and the sowing of a spring crop, and raising the underground water-level sufficiently near the surface to enable the people to ripen their spring crops by means of wells. And it is towards this end that we should shape our policy. We should keep moving the waters of the rivers ever eastwards and southwards. We should encourage as much as possible the sinking of wells wherever the water-level has been brought near the surface, and should gradually refuse irrigation in the winter season to such tracts, so as to compel the people to have recourse to wells and save the canal water for tracts farther south where the water-level is still deep. There are other than purely financial reasons for encouraging a great development of wells. It is better for the physical health and moral character of the people that they should have to labour on their wells than that they should sit idly

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watching the canal water flowing over their fields. Again, as things at present stand, think of the enormous responsibility that lies upon Government to maintain its canal system in full working order. If the Khanki weir gave way and was useless for even six months, many thousands of peasants on the Chenab Canal would at once be plunged into dire distress, as their fields would produce nothing. Whereas, if the water-level had been raised to working-point and the country were dotted over with wells, they would be able to irrigate their fields and get some produce out of the land. So that even if owing to some cataclysm the canal failed entirely, their destitution would come on only gradually and there would be time to arrange to provide for them elsewhere.

My recomendations therefore are that the waters of the Punjab rivers should be carried as far to the east and south as possible; that where the rainfall is good or the underground water-level sufficiently near the surface to make irrigation from wells practicable, canal water in the winter season should gradually be refused; that every possible encouragement should be given to the sinking of wells, and more particularly that ten lakhs of rupees should be placed annually at the disposal of the Punjab Government to be advanced on loans without interest for the construction of wells; and that we should gradually take into our canals more and more of the flood-waters of the rivers and spread them far over the country.

IV.—Replies to printed questions.

I have already submitted memoranda for the Irrigation Commission on the following subjects:—

I. Means of Irrigation of the Lower Bari Doab.

II. Irrigation of the River Valleys of the Punjab.

III. Future Irrigation Policy in the Punjab, with special reference to the development of irrigation by means of wells and inundation canals. I need not repeat what I have said in those memoranda.

A.—General.

1. I have special knowledge of the following districts of the Punjab:—

(1) *Gurgaon*, where I worked as Assistant Settlement Officer for two years, and where I assisted the Deputy Commissioner in granting remission of arrears and reduction of assessment on a large scale after the droughts and fever and loss of cattle and population of the years 1877-1882.

(2) *Sirsa and Fazilka Tahsils*, the assessment of which I revised in 1879-1882.

(3) *Shahpur district*, where I was Deputy Commissioner and Settlement Officer for eight years.

(4) *Rawalpindi district*, of which I was Deputy Commissioner for 2½ years.

I have also as Settlement Commissioner learned much of the agricultural condition of the following districts during the last two years, *viz.*, Jhang, Multan, Muzaffargarh, Dera Ismail Khan, Kohat, Hazara and Jhelum.

I propose therefore to answer the questions with reference to the circumstances of the Province generally, but with special reference to Shahpur and the south-western districts.

2. The total average annual rainfall varies, as a general rule, inversely with the distance from the Himalayas. Along the foot of the hills there is a zone of country where it amounts to over 30 inches per annum and is fairly certain, so that a large area of crops can be grown every year with the help of the local rainfall alone. Further out the average rainfall is between 30 and 20 inches, and becomes more uncertain, so that, while it is still possible in good years to grow a large area of rain-crops, they are more insecure and in years of drought either cannot be sown or fail largely. Still more to the south-west comes a zone where the average rainfall is between 20 and 10 inches and exceedingly variable, so that the rain-crops are very precarious. In a year of good rainfall, large areas are sown and give a handsome outturn, but in a year of drought practically no crops are matured except with the aid of irrigation. In the extreme south-west of the Province the rainfall is on the average less than ten inches and the area grown in dependence on the local rainfall only is quite insignificant, so that here the cultivation depends on the annual floods of the rivers or on wells and canals.

The importance of artificial irrigation varies inversely with the amount and certainty of the local rainfall. In the zone of fairly certain rainfall near the hills, though wells are sunk in great numbers wherever the conditions are favourable and the water of the hill torrents and springs is conducted on to the fields below, a large proportion of the crops are grown without any artificial irrigation. Further to the south-west, as the rainfall decreases in amount and becomes more uncertain, wells and canals become more and more important, until in the south-west of the Punjab, no attempt is made to grow a crop unless it can be irrigated by a well or canal, or sown on land moistened by the river-floods.

On what may be called the Northern Plateau, north of the Salt Range, comprising the Jhelum and Rawalpindi districts, and parts of Shahpur and Hazara, the country is so cut up by hills and ravines that it is impossible to construct large canals or to sink many wells, and although the rainfall is, towards the south of the Plateau, comparatively scanty and uncertain, the crops are almost entirely dependent on the local rainfall. Great pains are taken by means of an elaborate system of embankments, small and great, to retain the moisture on the terraced fields and to conduct the drainage of the higher lands on to them, but when the local rainfall fails, as it did disastrously in the Jhelum district in 1899, these embankments are useless and the fields remain dry and barren.

Again, in the Rohtak and Hissar districts on the borders of the Rajputana desert, when the rainfall is opportune, immense areas of the level light soil which characterises the tract, are ploughed and sown and produce a large quantity of grain and fodder, but when a year of drought comes, as it does about once in five years, the whole country is a desert (except where irrigation from one of the perennial canals is possible) owing to the fact that over almost the whole of this tract, the underground water-level is 80 feet or more from the surface, and irrigation from wells prohibitively expensive. On an average of years the tract produces enough grain to support a large population, but they are subject to the most violent vicissitudes of plenty and starvation.

In the almost rainless tract in the south-west of the Province a great deal has been done by means of inundation canals to spread the flood-waters of the rivers in the hot season over the country, sometimes at a considerable distance from the river bed, and as this process brings the underground water-level near the surface, irrigation from wells becomes easy, and large areas of crops are raised in summer by means of canal irrigation alone, and in winter by means of canal irrigation aided by wells, the canal water moistening the land for the sowing of a winter-crop, and the well irrigation during the winter, when the rivers have fallen and the canals have ceased to flow, bringing it to maturity.

During the last forty years a series of great canals have been constructed, taking out from the rivers soon after they debouch from the hills, and conducting their water over the vast stretches of comparatively high-lying land between the river valleys, much of which with its scanty rainfall and deep spring-level formerly produced hardly any crops. With the aid of weirs, these canals intercept the winter flow of the rivers as well as their summer floods, and thus give irrigation all through the year. They have made it possible to grow immense areas of crops where no crop was possible before, and rendered them secure from any but partial failure. The most striking example of these works is the Chenab Canal, which has brought under irrigation and cultivation a million and a-half of acres, formerly waste, and now supports in comfort a population of 800,000 souls where ten years ago only 60,000 found a scanty subsistence.

3. I do not think that anywhere extension of irrigation is hindered by sparsity of population or to any great extent by insufficient supply of cattle or manure. Where irrigation can be profitably extended, cultivators are easily found, and the necessary number of cattle is soon forthcoming, except in the case of poor individual owners whom liberal grants of *takavi* for bullocks would often enable to work their wells more fully. Nor is the soil unsuitable to irrigation anywhere in the Punjab except possibly in the Thal of the Sind-Sagar Doab, and even there I do not myself think that the poverty of the soil or the prevalence of sand-hills will be found too formidable an obstacle. The rise and fall of the annual floods of the snow-fed

rivers have proved favourable to the extension of irrigation. There are many tracts, however, where irrigation by means of wells would be much more common, were the underground water-table nearer the surface. The chief obstacle to the extension of irrigation, where irrigation is feasible and would be profitable, is the lack of capital for the initial expenditure whether on wells or canals. Once they are made, it is seldom difficult to keep them going, though at times the superior attractions of easier cultivation elsewhere may cause wells to be temporarily deserted, or the want of bullocks may cripple the peasant proprietor and make him temporarily abandon his well. If Government would itself spend more money on the construction of canals, and advance more money for the construction of wells, a very large extension of irrigation would result, and other difficulties would disappear.

The fear of enhanced revenue assessment has no appreciable effect in hindering extension of irrigation. The provisions for the protection of improvements against enhancement of the land revenue are well known and have the full confidence of the people, who continue to sink wells and make other improvements when a new assessment is impending just as if their assessment were fixed for years to come. For instance, in the Indus valley tract of the Dera Ismail Khan district, now under re-assessment, a thousand wells have been made in the last twenty years.

Tenants-at-will do not sink wells and are not likely to do so, so long as they remain tenants-at-will. A few of them might sink wells if they were given a right of occupancy, but there is no sufficient ground for such a sweeping change in the law. The present law provides that a tenant-at-will can make an improvement with the assent of his landlord, and thereby becomes entitled to compensation for the improvement on ejectment. Further than this the law could not go without undue interference with the rights of landlords. A tenant having right of occupancy is entitled to make improvements on his tenancy and is protected from enhancement of rent thereon until the land revenue is enhanced, so that he has the same inducement to make improvements that a proprietor has.

Punjab Tenancy Act, section 61.

Sections 63, 22.

All that is wanted to encourage extension of irrigation in the Punjab is the provision of capital for the constructions of wells and canals.

4. See Douie's Settlement Manual, paragraphs 502—505.

Land irrigated by a new well, dam or reservoir is protected from enhancement of assessment for 20 years; land irrigated by an old well, dam or reservoir repaired, for ten years; for a cut from a river or lake exemption from enhancement is allowed for from five to ten years. These periods are generally sufficient, and the Financial Commissioner has the power (never used) to great protection for longer periods when special reasons can be shown for this indulgence. In practice the exemption is secured by an inquiry made by the Settlement Officer into the case of every well made since last settlement, and the grant of a protective lease and exemption from wet assessment of all wells entitled to it under the rules. As an occupancy tenant cannot have his rent enhanced except in terms of the land revenue, he enjoys the same protection from enhancement on account of an improvement that an owner does.

In the south-western districts where the land without irrigation produces nothing, the rule till lately was that when a well was constructed to irrigate land beyond the reach of river-floods on canal waters half the assessment should be remitted. Recently, however, Government have extended the protection and ruled that in such a case no assessment whatever shall be realised on the land or well during the period of exemption. This liberal provision should further encourage the construction of wells in such tracts.

It is sometimes argued that an improvement effected by the expenditure of private capital should be exempted from enhancement of land revenue on that account for ever, but I am strongly opposed to the introduction of any such sweeping change in the assessment policy of the Punjab. One reason given for perpetual exemption is that it is economically wrong to tax the expenditure of capital on improvements. I cannot subscribe to this argument. It seems to me that accumulated capital in whatever form is one of the first things that should be taxed, and this is in accordance with the policy now adopted in England of imposing graduated death duties and a high income-tax. If a landowner, under the protection of our laws, has been able to accumulate capital and make a well, which adds considerably to his income, there is no reason why he should not pay to the State which protects him a portion of the enhanced income he gets from this investment of his capital. All that is necessary is that the enhancement of the revenue should not be so great or so sudden as to discourage such investments of capital, and experience shows that the assessment rules in force in the Punjab do not operate as any such discouragement. For during the past ten years the landowners of the Punjab have spent over 150 lakhs of rupees in making or bringing into use 53,000 masonry wells, although each man knew that his making a well would result in an enhancement of his assessment after the expiry of the period of exemption. There is, therefore, no need to grant a perpetual exemption from enhancement on improvements, nor can it be equitably claimed, nor does any landowner in the Punjab, unless prompted from without, think of claiming it.

If such perpetual exemptions were allowed, we should have in practice the anomaly that good well-irrigated lands producing valuable crops would pay a low rate of revenue, while poor crops on unirrigated lands would pay a rate of assessment much higher in proportion to the gross produce or to the net profits of cultivation. This would seem very unfair to the ordinary Punjab peasant, who has been accustomed to see the assessment proportioned to the net profits, and to some extent to the gross produce of the land, and to my mind would be really inequitable, if the period of low assessment were extended for longer than was necessary to give the improving landowner a fair return for the capital spent by him on his improvement. It would be all in favour of the capitalist and would by comparison injuriously affect the poor peasant with no capital. There would be great danger, too, of its directly injuring the owner of unimproved land. Along with the theory of not taxing improvements, goes the theory of assessing land not according to its actual produce but with reference to its capabilities, and we should probably not only have improved land assessed at very low rates in comparison with the actual profits, but unimproved land assessed at rates high in comparison with its actual profits, on the ground that it might be improved, say, by the sinking of a well where the spring level is near the surface. This would be grossly unfair to the poor man who had not the capital to make the improvement, and would tend to compel him to part with his land to a capitalist. I trust therefore that the Punjab with its three million of peasant owners, most of them without sufficient capital to make expensive improvements on their land, will be saved from the application of this theory, and that the present period to exemption from enhanced assessment, which is ample to give the improving owner a fair return on his capital, will not be extended.

Report of Indian Famine Commission, 1901, para. 320.

I think, however, that the present rules might be made more liberal, not only in order to encourage improvements, but in order to make them more equitable Proviso (b) of the rules is as follows :—

> "Provided that no lease shall be given on account of a well or other work constructed to water land already assessed at irrigated rates, as a lease is intended to secure the owner against an enhancement of assessment, and not to entitle him to the remission of any part of the demand already in force."

The actual working of this proviso is as follows. The Settlement Officer at a revision of assessment assesses a well owned by A and the land attached to it at Rs. 30 wet assessment. He finds that the well was made five years ago at a cost of Rs. 300 in land previously uncultivated and unassessed, and therefore gives a protective lease for 15 years and assesses the land at the unirrigated rate at Rs. 10, deferring the realisation of the Rs. 20, which represents the wet part of the assessment, for the remaining 15 years of the period of exemption. He finds another well adjoining it, owned by B, of exactly the same character, and assesses that and the land attached to it also at Rs. 30. B points out that he also five years ago made the well at the cost of Rs. 300 and claims the same exemption as A has got, *viz.*, a reduction of his assessment by Rs. 20 for 15 years, but on referring to the old records it is found that at the last settlement 30 years ago a well was in existence in

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B's holding and that his land was then assessed at irrigated rates, so although he shows that old well fell in and that he had to go to the same expense to keep his holding irrigated that A incurred to bring a bit of waste land under irrigation, he is told that under the proviso quoted he can get no remission. B does not see the justice of this decision; nor do I; and I have often been sorry to have to refuse an exemption on this ground, when announcing new assessments. If the object of the rules is to encourage the making of improvements, it is surely as important to encourage B to make a new well to take the place of the old one that has fallen in, as it is to encourage A to make a new well to irrigate waste land. On the other hand, if the reason for the rules is that A by making a new well increases the land revenue assessment and is therefore entitled to some return on his capital by exemption for a time from the assessment that would otherwise be imposed, surely B is equally entitled to an exemption when, by making a new well to take the place of the old one, he has prevented the land from falling into a state of waste, and saved the State from having to reduce the land revenue on his holding.

Multan Settlement Report, Appendix VII.

In the case of the Multan district Government have recently sanctioned a more liberal rule as regards wells that may hereafter be made. The new rule for that district runs as follows:—

> "If a new well is made to take the place of an old well which was assessed to revenue at settlement, or if an old well incapable of use has been repaired, a protective lease will be given exempting the well from any fixed well assessment, in addition to the land revenue, if any, already assessed upon it, from the date on which the well was made or its repair completed, but the term of exemption will be fixed by the Deputy Commissioner with reference to the expenses incurred, and shall not exceed ten years."

This rule has been made for a district where the assessment will be fluctuating, and where, when a well falls out of use for any cause, the fixed well assessment imposed upon it will be at once remitted. But I trust that the more liberable policy here adopted will be extended to other parts of the Punjab and to wells already in existence. I recommend that in place of the present proviso (*b*) the following rule be adopted:—

> "Where a well or other work has been constructed to irrigate land already assessed at irrigated rates, the Settlement Officer may, at a revision of assessment, grant an exemption from irrigated rates to the land irrigated by the well or other work, as if it had been previously unirrigated, but in fixing the period and amount of the exemption, he shall take into account the expenses incurred, and shall in no case grant a larger exemption, or for a longer period than would have been allowed for a new work on land previously unirrigated."

Under this rule Government would lose for a time the assessment at irrigated rates that would under the present rules be realised on land irrigated by a new well made to take the place of an old one, but it is so important to encourage the construction of wells, even to take the place of old ones that have become useless, and the reasons of equity in favour of the concession are so strong, that I trust Government will accept the small loss the change would entail. As the proposed rule would tend to prevent irrigated lands from being allowed to revert to a state of waste, it would probably in the end bring more gain than loss to the State.

In another direction, I think, we should be more liberal in our treatment of wells, especially in the comparatively rainless tracts in the south-west of the Province, where if a well, unaided by canals or river-floods, ceases to be worked the land produces absolutely nothing. At the recent re-assessment of the Multan district it was found that no less than 2,000 wells assessed to fixed land revenue at the previous settlement had gone out of work, and yet the lands attached to them, though in many cases they produced absolutely no crop, were paying Rs. 30,000 land revenue per annum. In many such cases the well had lain idle, and the land barren for years, and yet the landowner, often a poor peasant, had gone on paying to the State his Rs. 15 or 20 assessment year by year. What wonder that many of them were driven into debt and had to part with their land to men of more capital! To obviate such cases in future, Government have sanctioned the following rule for the Multan district:—

> "When a well falls out of use for any cause, the fixed well assessment which was imposed on it at settlement will be remitted from the first *rabi* harvest in which the well was out of use."

It is to be hoped that this rule will be extended to any tracts in which the assessment is wholly or partly fluctuating.

Again in the Thal it was found that many wells out of use, with lands that produced no crop, were still paying the assessment fixed on them at settlement, but in recent years Government have ordered the suspension of the revenue due on all such abandoned wells, and no doubt these suspended arrears will be remitted in due course.

There are still, however, very many wells in tracts wholly or partly under fixed assessment which continue to pay revenue, though they have been abandoned and though their lands produce nothing, or only a scanty unirrigated crop. In a recent tour in the Jhang district I have come across many such wells, and I believe they are numerous in Montgomery and in some other districts of the comparatively rainless tract. I have always felt strongly that it was extremely harsh and often cruel of Government to go on realising revenue in such cases, and have longed for the day when a more just and generous policy would be adopted. The system has been justified by the argument that when the assessment of an estate has been fixed for twenty or thirty years, the profit and loss are the affair of the landowners of the estate, and as Government cannot raise the assessment, neither should it lower it because a well has fallen in and the remedy pointed out is a redistribution of the assessment over the holdings comprising the estate. As a matter of practice, this remedy is applied only in the rarest cases, the reason being that neither Collector nor people feel it to be just that because B's well has fallen in, A's assessment should be increased. Besides under the system of exempting improvements from enhancement, new wells made in other parts of the estate cannot be made to bear a part of the assessment of a well that has fallen in. The result is, as I have said, that the Collector has to go on, perhaps for years, realising revenue from the wretched peasant whose well is useless and whose lands produce nothing, and it is only when a revision of assessment comes round that the needed relief is given, and most likely by that time the original proprietor has found it impossible to go on paying the land revenue on his barren holding and has parted with it to some man of capital who can afford to wait. This is no exaggeration. There are hundreds, if not thousands, of such cases in the Punjab at this moment.

In the case of the Sinawan Tahsil of the Muzaffargarh district Government have recently accepted the principle that when a well falls permanently out of use, a remission of that portion of the assessment which is charged on the irrigation from the well may be granted, if the Deputy Commissioner is satisfied that there was good reason for its abandonment, and that the owners have not sufficient land elsewhere to enable them to pay the revenue of the deserted holding. When a holding, the revenue of which has been remitted under the above rules, is again brought under cultivation, the remitted revenue, or such portion of it as the Deputy Commissioner shall see fit, may be reimposed.

I recommend that a similar rule be extended to all the comparatively rainless districts of the Punjab, whether their assessment is coming under revision or not; and made even more liberal. It might run as follows:—

I. "In tracts where the assessment is partly fixed and partly fluctuating, when a well falls out of use for any cause, the fixed well assessment imposed on it shall be remitted from the first *rabi* harvest in which the well was out of use; and when a well, of which the fixed assessment has been remitted under this rule, is again brought into use, the fixed well assessment formerly imposed on it shall, unless it is remitted under a protective lease, be reimposed with effect from the first *rabi* harvest in which the well is in use.

II. In tracts where the assessment is wholly fixed, when a well falls out of use, the Deputy Commissioner shall consider whether that part of the assessment which represents the profits of irrigation from the well should not be

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remitted. If the land attached to the well remains wholly uncultivated, he shall remit the whole assessment on the well-holding with effect from the first *rabi* harvest in which the well was out of use. If the land attached to the well continues to be cultivated with the aid of another well, or of canals, river-floods or local rainfall, he shall give such a remission, not exceeding the sum assessed on the profits of the irrigation from the well, as he considers fit with reference to all the circumstances of the holding. When a well, of which the assessment has been wholly or partly remitted under this rule, is again brought into use, the assessment remitted, or such portion of it as the Deputy Commissioner shall see fit, shall, unless it is remitted under a protective lease, be reimposed with effect from the first *rabi* harvest in which the well is in use.

Note.—These rules apply also to *jhalars.*

I would extend these rules, in the first instance, to the districts of Dera Ghazi Khan, Muzaffargarh, Multan, Mianwali, Jhang, Montgomery, Shahpur, Gujrat, Gujranwala, Lahore, Ferozepore and Hissar. They should not be applied to tracts irrigated from perennial canals, as there the well is often abandoned because irrigation from the canal makes the crops sufficiently secure. Nor would I apply them, in the first instance, to districts with more certain rainfall, as in such tracts the well is often not worked in good years and is maintained chiefly as an insurance against seasons of drought.

The introduction of such a rule would of course entail some loss of revenue on Government, as we should have to remit revenue on wells that fall out of use and could not impose new revenue on new wells until the period of exemption had expired, but I would ask Government to accept this loss rather than continue the harsh and unsympathetic policy of realising revenue from abandoned wells and barren fields. In the end too the gain would be greater than the loss, because the sinking of wells would be greatly encouraged, if the landowner were sure that he would not have to pay an assessment on his well in years in which it is out of work, and because the pitch of assessment on wells could be safely raised, if we were sure that the revenue would be remitted when the well was abandoned. It is not, however, which a view to an ultimate increase in the revenue, but in the name of justice, that I urge this reform in our assessment policy.

5. The rules for the grant of loans under the Land Improvement Act have recently been made more elastic, and although they are, I think, capable of further improvement, they are not the chief obstacle to the more general employment of such loans in extending irrigation. The chief hindrance is that the Government will not provide sufficient funds to meet the demands of the people under the present rules, and so long as their present requirements are not met, it seems of little use to propose further modifications of the rules. The Deputy Commissioner of Delhi tells me he has applications for Rs. 50,000 *takavi.* The Tahsildar of one tahsil in Muzaffargarh has applications for Rs. 20,000. The Settlement Officer of Dera Ismail Khan could dispose of Rs. 25,000 a year. But the money is not forthcoming. There is little encouragement to the people to apply for loans when they have to be told that their applications are approved, but cannot be granted because there are no funds. Moreover, it is very bad finance to stint these grants, apart altogether from the great benefit to Government from the extension of irrigation in ultimate enhancement of the land revenue and immediate security of the crops. The Punjab Government has practically no bad debts and clears an annual net profit of Rs. 40,000 a year on this branch of its money-lending business, so that, apart from more statesmanlike considerations, motives that would say selfish bankers should induce Government to advance as much money for land improvements as the people will take on the present terms. I would urge that ten lakhs of rupees per annum should be placed at the disposal of the Punjab Government for advances for land improvement, and that this sum should be made available every year whatever be the demands on Government for famine expenditure and other loans. If Deputy Commissioners and people knew that their requirements under this head would be regularly met, the demand would be steady and much greater even than it is. And it should not be difficult to finance such loans where they give, as they at present do, a certain return of 6¼ per cent. per annum. Until the Government can find the funds to advance on these terms, there seems little use in asking them to make the terms more lenient. I desire, however, again to point out how profitable an extension of irrigation by means of these loans is to Government, apart from the interest received. If by making an advance of Rs. 300 we can induce a landowner to make a well, then after the expiry of the twenty years' period of exemption, the land revenue can, in most districts, be enhanced in consideration of the existence of the well, by about Rs. 20 per annum, so that although Government will get no return from its loan, other than the interest it claims, for twenty years, it will then get, by way of an enhancement of land revenue, a return of over 6 per cent. on its loan, the capital of which will, by that time, have been repaid; so that it would be a pure financial gain to Government in many cases to advance money for such improvement free of interest altogether. It would lose the interest for twenty years, but would after the twenty years get 6 per cent. on the loan (already repaid) as long as the well lasted. Apart from these purely financial considerations there are the more general considerations that the construction of irrigation works renders the crops more secure, increases the produce of the country and makes the people more able to endure the effects of drought. I recommend therefore that where the landowners are not willing to take loans on present terms, and after Government has found the funds to meet the demands of those who accept the present terms, the offer of loans without interest be made for the making of wells where the Deputy Commissioner is satisfied that they would be worked and would be useful. When all demands on those terms had been met, if there were further funds available, it would in some parts of the province be ultimately profitable to Government to make advances on condition that when the well is made and worked, a portion of the advance will be written off, but I would not offer advances on these terms until we have satisfied the demands of those people who are willing to take loans without any such inducement.

See my previous note on Future Irrigation Policy in the Punjab.

The policy of suspension and remission of land improvement loans in the Punjab is fairly liberal, but it might perhaps be laid down more decidedly that when the improvement fails of its object, owing to the misfortune and not to the extravagance of the borrower, the loan should be recommended for remission. The fact that the amount of such loans written off as irrecoverable is less than a half per cent. per annum goes to show that the policy in this respect is not sufficiently liberal. I think that in no case should compound or penal interest be exacted. This savours too much of the *baniya,* and the Collector's powers of recovering the loan and interest as an arrear of land revenue give quite sufficient security.

Report of Indian Famine Commission, 1901, para. 317.

The period of repayment of a loan for a well may, under the present rules, be extended to twenty years, which is quite long enough; but in practice it is seldom extended over twelve years. I think that ordinarily it should be made to end with the period of exemption, so that as soon as the loan has been repaid the landowner will begin to pay the enhanced land revenue. The account should be made simpler, the borrower being told only how much he must pay every harvest in even rupees for so many years without being troubled with details of principle and interest. Where the land revenue assessment fluctuates with the crops of each harvest the realisation of instalments of the loan should be made to fluctuate in proportion, so that what the landowner has to pay each harvest may be proportioned to his actual income from his crops.

If the Government will make available sufficient funds, it would be advisable to depute a special officer to go round to the different districts and assist the Deputy Commissioner in making loans. He should have experience in judging of the capabilities of land for irrigation and should be empowered, when he has satisfied himself that a well can and will be profitably made and worked, to disburse the money on the spot and draw up the necessary papers with as little delay and formality as possible. If this were done, I believe the demand for such loans would greatly increase. It might at least be tried, and if it did not succeed might be stopped before it could do much harm. The officer should have attached to him a subordinate expert with boring tools, to ascertain, free of expense to the

Report of Indian Famine Commission, 1901, para. 317.

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landowner, what the subsoil and underground water supply are like. This would save much waste of money in fruitless attempts at well-sinking.

6. I have in my note on the Irrigation of the River Valleys of the Punjab pointed out how much the population of those valleys has been injured by the opening of perennial canals in their neighbourhood; and how it is incumbent on Government to take measures for the maintenance of their prosperity by extending irrigation to their lands at the capital cost of the canals, and urged that (1) a grant of ten lakhs of rupees should be made annually from Loan Capital for the improvement of inundation canals and (2) a complete survey should be at once undertaken of all the river valleys of the Punjab.

B.—Canals of continuous flow.

7. Where a canal has been made to irrigate a tract in which the rainfall is scanty and the underground water-level far below the surface, as in the case of the Chenab Canal, it makes cultivation possible where it was impossible before, and the whole of the produce may be credited to the canal. Where, as in the case of the upper portion of the tracts irrigated by the Lower Bari Doab Canal, Sirhind Canal and Western Jumna Canal, it irrigates lands previously cultivated by the aid of the local rainfall and wells, it makes the crops more secure, it enables them to be matured with less labour, it increases the yield of crops on lands previously unirrigated, and enables a larger area of crops and better qualities of crop to be grown. For instance, sugarcane, rice and wheat are grown on larger areas, and the actual value of the crops produced is enormously increased.

On a canal like the Chenab Canal which irrigates a comparatively rainless country, the yield, even in a year of, for the tract, ample rainfall, depends almost entirely on the canal, and the demand for water and area irrigated, fluctuate little from year to year. On the Sirhind Canal, on the other hand, the light soil of the tract commanded produces wonderfully good crops in a year of ample rainfall, without irrigation, so that in such a year the demand for water and the area irrigated by the canal fall off in a very marked degree. In a year of scanty rainfall irrigation greatly increases the yield and the demand for water is brisk, while in a year of drought in the Ferozepur, Hissar and Rohtak districts irrigated by the Sirhind Canal and the extensions of the Western Jumna Canal, nothing at all would be produced, were it not for the canals, and every drop of water available is eagerly utilised.

8. On the Chenab Canal the whole produce is due to the canal. Its value may be estimated on the average of a normal term of years at Rs 25 per acre, taking wheat as the normal crop giving 12½ maunds per acre at Rs. 2 per maund. In a year of drought it will give 10 maunds per acre at Rs. 3 a maund or say Rs 30 per acre.

On the lower part of the Sirhind and Western Jumna Canals on an average of years the produce of the land is increased by canal irrigation from about Rs. 5 to about Rs. 15 and in a year of drought from *nil* to Rs. 20. In the upper part of the Sirhind and Bari Doab Canals where cultivation by means of wells and the local rainfall is possible, the value of the crops grown is increased by canal irrigation in a normal year from about Rs. 15 to about Rs. 30, and in a year of drought from about Rs. 10 to Rs. 40.

9. On the Chenab Canal the rates are levied on the area actually irrigated for each harvest. Government, the owner of the land and canal, realises from the colonists altogether about Rs. 5 per acre irrigated, of which Rs. 3-12 is considered as the price of the water (occupier's rates) and the remainder land revenue, rent and cesses. The colonist, when he does not cultivate the land himself, sublets it to a tenant who usually pays him half the gross produce, besides paying half the water-rates. The average income of the colonist from the tenant in such a case is at least Rs. 12 per acre, leaving him a net profit of about Rs. 7 per acre.

On lands owned by private individuals the occupier's rates charged amount to about Rs. 4-4 per acre, the cultivator pays the owner one-third of the gross produce, *plus* the water-rate, and the owner of the land pays to Government one rupee per irrigated acre as owner's rate. As the value of the produce has been increased by the introduction of canal irrigation from about Rs. 8 to Rs. 25 and the owner's share has risen from one-fourth to one-third he gets from the tenant instead of Rs. 2 about Rs. 8, besides the occupier's rate, and as his payments to Government have increased from 8 annas to about Rs. 1-8 per acre, his net income has risen from Rs. 1-8 to Rs. 6-8 per acre. These tracts (Jhang and Hafizabad) are about to have their assessment revised and the opportunity will probably be taken to secure a portion of these great profits to the State. In the lower portions of the Sirhind Canal where the soil is light and the population scanty, Government realises about Rs. 2-8 per acre actually irrigated, and so far has not realised any owner's rate or enhancement of land revenue; but as the Fazilka Tahsil is now under re-assessment, the land revenue is likely to be largely enhanced. The landowner used to realise from the tenant about six annas per acre under cultivation equal to about eight annas per acre harvested. He now realises (besides the occupier's rate which is paid by the tenant) one-fourth of the gross produce, or about Rs. 4 per acre, so that his profits have very greatly increased. In the upper part of the Sirhind and Bari Doab Canals also the rents paid by tenants to landlords on canal irrigated lands have increased much more than in proportion to the payments made by them to Government. I am strongly in favour of securing to the State, which has by the expenditure of its capital constructed these canals, a large share of these enormous profits made by landlords owing to the introduction of canal irrigation, and I think no opportunity should be lost of doing so, whether by enhancing the occupier's rates, enhancing the land revenue or imposing an owner's rate.

10. The cost of constructing water-courses from the canal-distributaries to the fields and of preparing the land for irrigation is generally borne by the landlord. It is small in comparison with the profits of irrigation, and landowners have little difficulty in finding the money. In the rare cases in which the tenant incurs the expenditure he would be entitled to compensation on ejectment.

11. On the Western Jumna Canal great injury was done to the soil and to the health of the people by excessive irrigation, and by the bad alignment of the canal which intercepted the natural drainage and gave rise to water-logging, to spread of salt efflorescence and the prevalence of fever and spleen disease. But of recent years the canal has been realigned, the drainages opened up, and excessive irrigation discouraged, with excellent results. The evils formerly complained of have been very much diminished and the condition of the soil and the health of the people greatly improved. The perennial canals more recently made have been carefully designed, and these evils are nowhere serious. There are signs that incessant cultivation without the aid of manure is exhausting the fertility of the soil but not to any alarming extent, and the only feasible cure seems to be a more extensive use of manure and the growing of less exhausting crops, which the cultivators will no doubt learn in time. The introduction of canal irrigation into a formerly dry tract is generally followed by epidemics of fever, for which there seems no remedy except perhaps the gradual discouragement of excessive irrigation where it is found to exist. The people get accustomed to it, and would rather have the fever and the irrigated crops, than escape fever and suffer from semi-starvation.

I am of opinion that we should go on extending our system of canals of continuous flow by damming the rivers by means of successive weirs and spreading their waters far over the dry country to the south-east; and that by gradually discouraging excessive irrigation in the upper part of the commanded area we should extend the benefits of canal irrigation over as much available good land as possible and induce the people to supplement the canal irrigation by sinking and working numerous wells.

See my note on Future Irrigation Policy in the Punjab.

C.—Canals of intermittent flow.

12. The inundation canals of the Punjab, on which so large a proportion of the cultivation in the south-west of the province depends, are drawn from the Punjab rivers in the summer season when their rise, due to the melting of the Himalayan snows and the rainfall on the lower hills, makes it possible to draw off a portion of their floods without the aid of a weir across the river. In an ordinary year they commence to flow about the middle of April, and cease to flow in the middle of September, but the dates of commencement and cessation depend on the melting of the snows and on the rainfall in the distant hills and vary in the one case between the 15th March and the 15th May, and in the other between the 1st of

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August and the 1st of October. The canal head is dug at such a level that when the river rises, water will flow down the canal, which is so constructed that after some miles the water commands the country, sometimes on both sides, but more especially between it and the river, by means of water-courses, taken off from the canal, often by merely digging a hole in the bank without any masonry outlet.

13. The greater part of the country irrigated by inundation canals has a very small rainfall, and but for the canals would grow nothing at all except a few acres on scattered wells. The outturn does not depend very much on the local rainfall, although opportune showers do increase the yield appreciably. The average value of the gross produce of land irrigated by these canals without the aid of wells may be estimated at Rs. 12 per acre, the whole of which should be credited to the existence of the canal.

14. If the canals commence to flow late, there is not time to sow cotton and indigo, which are the most valuable autumn crops grown to any great extent on these canals. If they cease to flow early, the autumn crops wither, and there is no moisture on which to sow wheat and other winter crops.

15. A large area is irrigated by these canals without the aid of wells and is generally put under cotton, indigo, millets, pulses and other autumn crops, but it is usual to employ the later supplies of canal water in moistening large areas of land on which to sow wheat, barley and other winter crops, and to mature them by irrigating them all through the winter by means of numerous wells. Were it not for the wells, these canals would produce practically nothing but autumn crops, and their value would be lessened by half. It is essential, therefore, to encourage the construction of wells in such a tract, and this is generally easy, as the underground water level in a tract within reach of an inundation canal is generally within 30 feet of the surface, and a masonry well can be made for Rs. 300 or less and can be worked by small and cheap bullocks.

16. I have given under 13 an estimate of the average value of crops irrigated by canal alone. The average value of crops irrigated both by canal and well may be estimated at Rs. 20 per acre (say 10 maunds of wheat at Rs. 2 per maund) and practically the whole of this may be credited to the canal, as without the canal many of the wells would fall out of work. As already said, the outturn does not vary much in a year of drought, and any falling off in the outturn would be counterbalanced by a rise of price.

17. In Multan and Muzaffargarh the canals are managed and practically owned by Government, and until lately the clearances annually required were done by the irrigators themselves under an organised system of statute labour, but at the recent resettlement of the Multan district this system has been abolished, and now the irrigators pay to Government water-rates charged on the matured area of irrigated crops, and averaging about Rs. 1-4 per acre. It is proposed to make a similar change in Muzaffargarh, and there the water-rate will probably average about Re 1 per matured acre of irrigated crop. This will ordinarily be paid by the tenant. The landlord in these tracts almost invariably takes a share of the produce by way of rent, averaging about one-third of the gross produce on land irrigated by the canal alone and about one-fourth on land irrigated by both canal and well. His net profits, after allowing for cost of maintenance, are about Rs. 3 per acre on land irrigated by canal alone and Rs. 4 on land irrigated by canal and well, and he pays in land revenue to Government about Rs. 1-4 on the average. The whole of this may be considered as due to the canal, as without the canal there would be practically no crop at all in such a tract.

On the Shahpur inundation canals the clearance is done at the cost of Government and a water-rate of Rs. 2-8 per matured acre is taken. Besides paying this, the tenant pays the landlord one-fourth of the gross produce as rent equal to about Rs. 3 per acre and the landlord pays to Government six annas fixed land revenue per acre on the total cultivated area, and eight annas water-advantage revenue, on the matured area, the total charge being equal to about Re. 1 per acre of matured crops, so that including the water-rate Government realises about Rs. 3-8 per acre of matured crop, on land which would produce it almost nothing, were it not for the canal.

Private canal-owners take one-fourth of the gross produce as the price of the water, besides one-fourth as rent. This is equal to about Rs. 3 per matured acre. They pay Government 8 annas per matured acre as royalty, which leaves them a very handsome profit on their capital expenditure on the canal.

18. In Multan the water-courses from the canals are often very long and require a very heavy expenditure in annual clearance. Where the cost is great, it is defrayed by the landlord, where small, by the tenant, who pays a lower rate of rent in consideration of his labour on clearance. A similar custom prevails in Muzaffargarh, but there the cost of clearance is not so great. The most crying need on these canals is a better system of distributaries which would obviate all this annual waste of labour. This can be given only by Government and should have been given by Government long ago.

19. In some places over-irrigation has led to water-logging and the spread of salt efflorescence, but recent experiments in the direction of reducing irrigation in such tracts have greatly diminished the evil For instance, the civil station of Shahpur was suffering seriously from water-logging which led to the collapse of several houses, but when irrigation had been reduced the level of the underground water fell. Similarly, round the town of Sinanwan in the Muzaffargarh district, excessive rice-irrigation had caused serious water-logging and spread of salt efflorescence, but now that less water is supplied to the neighbourhood, these evils have been greatly mitigated. In some places the cultivators take too much water for rice cultivation and an enhancement of the water-rate charged for rice has been found beneficial. I think that in most places it is quite possible to reduce water-logging and the spread of salt efflorescence by reducing the water-supply, and that this should generally be done where these signs of over-irrigation appear, even although it may mean temporary hardship to the irrigators.

It is a common complaint that land which has been cultivated for some time with the aid of canal irrigation deteriorates in productive power and there is some truth in the assertion, but I believe it is greatly exaggerated, and that after a certain limit has been reached the productive power of the soil remains fairly constant, especially where the canal water, as it often does, brings with it a quantity of fertilising silt. (This is especially the case with the water of the Jhelum river which is famous for its fertile silt.) The only remedy for the deterioration is the more frequent use of manure which is gradually becoming more common, especially where wells are made to supplement canal irrigation.

20. Many of the inundation canals of the Punjab belong to Government, and their maintenance and repairs are managed by the Irrigation Department, the annual cost being about one rupee per acre irrigated. In Multan and Muzaffargarh the annual clearances have hitherto been done by the irrigators under the control of the Irrigation Department, but the system was wasteful and dilatory and led to many abuses, and is now in process of abolition, and on those canals also the clearances will in future be done by paid labour, a cash rate being charged for the water. On the Ferozepore system of canals, the clearances are done by the irrigators, and the system works fairly well under the supervision of L. Maya Das, but I think that in time it will have to make way for the more usual system of clearance by paid labour. In private canals generally the clearances are done at the cost of the canal-owner, who often gets the irrigators to work on them at a low wage. Probably the actual cost in cash to the canal-owner is not over eight annas per acre irrigated. But the clearances are often neglected or badly done, especially where the canal-owners are bad managers or quarrel among themselves. For this and other reasons legislation giving Government better powers of control over private canals is urgently required. A Bill for the purpose has been under consideration for more than ten years, and there now seems some hope that it will shortly be passed into law.

21. The Ferozepore canals were nominally constructed by the irrigators, but their labour was organised by Colonel Grey, the Deputy Commissioner, and his successors. A number of the canals in Shahpur were made by private persons, and several of them are well managed, the owners realizing without trouble one-fourth of the gross produce from the irrigators as the price of the water. Others are badly managed, the supply of water is very irregular and disputes frequent, and it would be to the advantage of all concerned if Government could take over the management of such canals, but it cannot do so until the Act above alluded to is passed. It has, however,

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acquired some of the smaller private canals by purchase, and amalgamated them with its own canal system.

22. I am not in favour of encouraging private persons to construct further canals. Experience shows that their management is rarely satisfactory and that it is much better in the interests of the land-owners that Government should make the canals and have complete control over them. I should encourage the construction of a private canal only where I despaired of getting Government to construct it within a reasonable time, and then only on condition that Government should have full power to step in and assume the management whenever it thought proper.

D.—Tanks.

I have no recent experience as regards irrigation from tanks. I do not think it can be practised on a large scale anywhere in the Punjab, except perhaps in the Gurgaon district.

E.—Wells.

I have made some remarks about wells under head A.

34. In the Shahpur district the depth to water varies from a few feet near the river to 60 feet or more in the centre of the upland tract. The average depth may be taken as 25 feet, the average cost of construction Rs. 300, the average duration 50 years, the average area attached to the well 34 acres, and the average area actually irrigated and producing a crop in the year 25 acres. For the whole South-West Punjab, where wells are assisted by irrigation from canals, the average depth to water may be taken as 20 feet and the average area of crop harvested as 20 acres per annum. The water in all this part of the Punjab is raised by means of the Persian wheel and generally depends on percolation, and is rarely liable to fail seriously or become too saline, though in a year of prolonged drought the supply is not so plentiful as in an ordinary year.

35. In these comparatively rainless tracts a well makes it possible to mature a very much larger area of crop than could be watered by means of canal alone, especially in the *rabi*, when it is common for a large area of wheat to be sown with the aid of the moisture left by the last floods of the hot season, and matured by means of irrigation from the well, which is worked all through the winter. A certain limited area in the immediate neighbourhood of the well is manured and produces two crops in the year or a more valuable crop, such as cotton or sugarcane, but a considerable area has to be sown with turnips or other fodder crops for the support of the well bullocks through the winter.

36. In such a tract on an average of a term of years, a well matures 20 acres of crop worth about Rs. 400 where, if there had been no well, but only canal irrigation, the crop matured would have been only 12 acres worth about Rs. 150 and where, if there were neither well nor canal, there would have been no crop at all. On the average every well at work in the south-west of the province (there are over 70,000 of them) adds crops worth Rs. 250 per annum to the produce of the country.

37. In those tracts rent is usually paid in the form of a share of the produce, the most common rate of rent on land irrigated by wells being one-fourth of the gross produce, while on lands not so irrigated the usual rate is one-third, the produce on irrigated land being so much greater that the smaller fraction gives the landlord a larger amount of rent. The average value of the rent on land irrigated by canals or river-floods only may be taken at Rs. 3 per acre and on land irrigated also by wells at Rs. 4 per acre, after allowing for cost of maintenance.

As already explained, a new well pays no enhanced land revenue to Government for twenty years. Thereafter it pays an increased assessment of about Rs. 20 per well. I have in a previous part of this note pointed out how profitable to Government is the construction of a well, and how Government might profitably grant a *takavi* loan of Rs. 300, free of interest, for the construction of a well, which, although it would pay no enhanced revenue for 20 years, would thereafter pay Government Rs. 20 enhanced revenue equivalent to more than 6 per cent. on the capital expenditure, which by that time would itself have been repaid, and equivalent, as Colonel Grey showed in his note, to 20 per cent. on the capitalised loss of interest. It is for this reason among others that I recommend that ten lakhs of rupees a year should be placed at the disposal of the Punjab Government for loans for the construction of wells, even if those loans have to be made free of interest.

Multan Settlement Report, paragraph 34.

38. It is frequently the case that a cultivator has doubts as to the proper place to sink a well owing to ignorance of the quality of the water and the nature of the *strata*, and it is not uncommon for money and labour to be wasted in digging for a well or even in actually constructing it in a place where it is afterwards found impossible to work it to advantage. I am of opinion that Government should appoint one or more experts to go round with boring tools from district to district and bore for water wherever it is proposed to sink a well, free of cost to the landowner. This assistance would be welcomed by the people, and would save the waste of much money and labour. In some places there is a substratum of hard clay which the ordinary well-sinker cannot penetrate, and the expert should have strong boring implements to enable him to penetrate such a stratum. The advantages to Government of an extension of well irrigation are so great that I think the cost of such boring operations should be met from Imperial or Provincial Funds.

39. I am not in favour of any extensive construction by Government of wells in land which is privately owned, as I think the wells would ordinarily be more cheaply made and worked by the owners of the land themselves with the aid of *takavi*. The plan might, however, be tried where the people will not take *takavi* and are willing to let Government sink wells in their land, on condition of their paying the enhanced land revenue at once. If Government at the cost of Rs. 300 can sink a well on which it will realise immediately an enhanced revenue of Rs. 20 per annum, the transaction would be financially profitable, besides its indirect advantages. And there is no harm in trying the plan, where the people agree.

40. Temporary wells are not used to any great extent except close to the beds of rivers and in the Umballa, Gurgaon and Rohtak districts in low-lying valleys where the water is near the surface. In such tracts they are, so far as they go, a valuable protection against drought. In recent years of scanty rainfall their construction has been encouraged with great success by the grant of small sums from Rs. 10 to Rs. 50 per well free of interest, and wherever their construction is possible, such advances should be freely given and indeed in time of famine pressed on the people that as large a food supply as possible may be raised.

In conclusion I venture again to urge—

I. That ten lakhs of rupees a year should be placed at the disposal of the Punjab Government for the encouragement for the construction of wells by means of—

(*a*) grant of loans on present terms;

(*b*) grant of loans on low interest or free of interest;

(*c*) construction of wells at Government expense in privately-owned lands;

(*d*) employment of a special agency to distribute loans and to bore for water.

II. That in addition to the sums required for the maintenance of existing inundation canals, a sum of ten lakhs of rupees a year be placed at the disposal of the Punjab Government—

(*a*) to enable it to complete the survey of the river valleys;

(*b*) to be expended on the construction, extension and improvement of inundation canals.

Col. S. L. Jacob.

Colonel S. L. JACOB, late of the Punjab Irrigation Department.

(1st May 1902.)

Paper on Irrigation and Famine Prevention in the Punjab.

PREFATORY REMARKS.

It should be fully understood that the few allusions which are made in this paper to the defects of the past are merely for the purpose of obtaining the needed moral for the future, and certainly not for the purpose of finding fault.

Irrigation is a new and difficult science, and the wonder is, not that mistakes have been made, but that they have not been far more numerous and more serious. That the record of the Punjab Irrigation Department is a splendid one is now fully acknowledged on all hands, and the sole object of this paper is to seek to benefit that Department, and to serve the Government under which, and the people amongst whom, the writer spent the best years of his life.

1. *A retrospect.*—Twenty years ago the Punjab Irrigation Department was thoroughly discredited.

The Western Jumna Canal irrigation was falling lower and lower. Much of the country irrigated was becoming barren, and injurious to the health of the people, owing to its being water-logged.

The Bari Doab Canal, with many radical defects, showed little or no promise of what it would become.

The Sirhind Canal was nearly ready for opening, but it had been very costly. Its accumulated interest was very great in amount, and there seemed no hope of its ever being a paying concern.

The Swat River Canal construction, greatly hampered by the Afghan campaigns, was dragging on with little prospect of a good return.

No large projects were being drawn out, for it had become a foregone conclusion that either they would not pay at all, or else only after so long a period that it was not worth while to go to so great an expense. Therefore it was that all that was contemplated were three tiny little projects, *viz.*, the Sidhnai, the Lower Sohag and Para, and the Ramnagar project (as the germ of the present Chenab Canal was then called).

2. *The present time.*—Now all this is changed. The Department is thoroughly accredited, and in a most prosperous condition.

The Western Jumna Canal has been vastly extended, its worst defects remedied, an immense boon to dry, thirsty tracts, its irrigated area nearly double what it used to be in its early days.

The Bari Doab Canal has also much extended, its irrigated area more than doubled, its defects removed, and the canal highly prosperous.

The Sirhind Canal, of immense value to the large tract it commands, is paying off its arrears of interest, and giving a good return.

The Swat River Canal is highly prosperous, its interest paid off, and excellent returns are received from it.

The Chenab Canal is barely finished, yet the desert it traverses is already blooming as a garden, and the project a marvellous investment.

The Jhelum Canal is just opened, and irrigation is opening out with great rapidity.

The Sidhnai, the Lower Sohag and Para, as well as the inundation canals, are all doing well. Thus, all is changed.

3. *The future.*—The question arises, what about the future?

Has the progress in the past nearly exhausted the capabilities of the situation, or are there still possibilities of progress as great as that which has already been accomplished? Have all the problems which presented themselves been already solved, or nearly so, or are there more difficult problems awaiting solution?

To these questions it is believed the answer is, that undoubtedly there are still vast possibilities of progress, and great problems to be solved, even more difficult than those already solved, but full of promise. Also, that it is possible to make—

(1) the Punjab more than ever the granary of North India on the one hand, and

(2) thoroughly famine-proof on the other.

4. *Scope of this paper.* The object of this paper is to give the writer's opinion as to the chief essentials of the problems to be solved, and the way in which the required objects can best be worked out.

5. *A first essential.*—The first essential is a profound belief in the possibilities of irrigation and great boldness in attacking the problems. It is due to the lack of this belief, and to the caution which has so often characterised the dealing with the questions that have arisen, that the successes attained have not been even greater than they are.

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6. *An illustration.*—Let us look at one instance. The Chenab Canal is a marvellous project and a tremendous success; nevertheless, it is boldly maintained that it has a great defect, which is due to too great caution, and this is that the canal head was not placed higher up the river. Can this be proved? We will see.

The extension project of the Chenab Canal was under preparation 11 years ago. The weir was in progress and the position of the head was therefore fixed; all that could then be done was to irrigate all the land that could be commanded from that head. The project was accordingly prepared to embrace all land commanded, of which the spring level was at least 40 feet below the surface. Yet even this was considered too bold a project, and a portion of the commanded area was cut off before it was sanctioned.

What, however, has been the actual result? Why, not only has the area cut out been taken back into the scheme, but also the further limits first proposed have been overpassed, and every bit of land under command, even as far as the 20 feet spring level limit, has been brought into the irrigated area.

Why is this? Just because the progress of the science of irrigation which has been attained render it possible for a given volume of water to irrigate so much more than it used to do.

Ten years ago 1,200,000 acres of annual irrigation from the water of the Chenab river was pronounced too high an estimate, and cut down to 1,100,000. To-day the Chief Engineer of the Punjab, speaking at the Society of Arts, says 2,500,000 can be done with this same water.

Now, even when all that is possible has been done in the way of bringing all potentially commanded land under actual command, will it be sufficient? Certainly not. Only a few more extensions are possible, and the present Superintending Engineer longs intensely to have more land under command, for he sees so plainly that, do what he will, he cannot get anything like enough land to really bring out the potentialities of the available water-supply; and if this is felt now with a canal not fully complete, and with much improvement possible, it is certain that it will be felt far more acutely year by year, and the mistake of not having put the head higher up when the canal was first constructed will be accentuated, for the 800,000 or 1,000,000 extra acres of good irrigable land, which would then have been commanded, are just what is wanted for the proper utilization of the available supply of water in the Chenab river. This would, of course, have made the project more costly, but it certainly was the right thing to do.

It may then be said for certain that, sooner or later, another weir will have to be built higher up, and a subsidiary canal made to take up this tract. The expense involved in the weir and in crossing drainages will certainly not prevent this scheme being carried out, but how far better, if the possibilities of irrigation could have been foreseen and the head placed further up in the first instance.

How important, then, to take large views of the subject, and always to bear in mind that whatever duties have been obtained from the water in the past, it is perfectly certain that far greater duties will be attained in the future. The waste, even in our best canals, is still enormous, so much so that it is doubtful if one-third of the water entering the canals reaches the fields irrigated. The waste from evaporation is trifling; it is the waste from absorption which is so great, and this latter waste is capable of great reduction by improvements, nay, *if it were worth while*, it would be possible to almost eliminate it. It may come to this one day, though it is a far cry at present; nevertheless, absorption can be greatly diminished, and improvements in other ways will yet greatly improve duties. This must ever be borne in mind, otherwise the schemes will never be bold enough, and much regret caused in the future. The lessons of the past will be in vain unless it is seen how greatly the present standpoint can be exceeded in the future.

7. *A second essential.*—To attack the problems in the best way they must be taken up on a very broad scale. They should be worked out in a general way by those at the head of affairs, and then the details filled up. The proper way is to work from the general to the particular, and not the other way, though this principle has not been observed in the past.

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8. *Illustration of the above.*—As an illustration it may be asked—

"Is it not true that the extensions to the original projects of the Western Jumna, the Sirhind, the Bari Doab, and the Chenab Canals, whereby these canals have attained to the measure of completeness which they possess, have in almost every case been brought about by the importunities of the local officers (Superintending Engineers as a rule), and not by the orders of Government?" "Is it not true that these extension schemes were in many cases delayed for months and years because it was said there was no water for them, and that the vested rights of the old irrigators would not be maintained?" "Is it not also true that in every single case the extensions, when carried out, have more than justified their existence, have injured none, have benefited many?" Let the Government now take the initiative and, recognising the great possibilities in this work, encourage its officers in the work of extension, realising that year by year canals, if properly worked, can irrigate more than they did before and that extensions, internally or externally, are the very breath of the nostrils of the canals; and without them a low stagnant condition will be reached and very likely retrogression set in. Rather let every bit of irrigable land be searched out and arranged for. Let a bolder policy now take the place of the former caution, for experience has shown that this can be safely done.

9. *Some hindrances.*—Two hindrances have been already alluded to, *viz.*, the fear of there not being enough water, and the fear of infringing on the rights of the old irrigators, and it has been shown that these fears have in no single case that actually occurred been justified in practice. They are in truth far too great a bugbear, owing to an imperfect sense of the potentialities of irrigation.

Some other hindrances which exist as to extension on a large scale may now be mentioned, as the ground will be thus cleared.

(1) There is the fear that the inundation canals will suffer if too much water is abstracted from the rivers.

As a matter of fact, all that can be abstracted by the permanent canal will affect the inundation canals only to a slight extent. It should, however, be clearly understood that inundation canals can never be allowed to interfere with the development of the country by permanent canals. The inundation canal is an excellent device in an early stage of civilization, as it enables good results to be attained very quickly and at slight cost.

As, however, civilization progresses, it is found that inundation canals are crude appliances, that they can only take a little water when the rivers are high, while the rest must pass on; while there is little power of regulating the supply, and, moreover, the canals often dry up prematurely.

Hence in a further stage of progress they must become more like the permanent canals and be served with weirs* built across the rivers at intervals, one head serving many of these canals. The supplies will thus be properly under command, and the fear of too early drying up will be obviated.

(The only thing that will have to be carefully guarded against is that the facility of obtaining supplies from the rivers does not lead to over-irrigation and water-logging.)

There need be no fear as to the construction of weirs across the Punjab rivers, even the mighty Indus itself will eventually have to submit to being bound, it being clearly understood that it is only a question of time for the remodelling of the whole system of inundation canals.

(2) There is a complaint in some cases that the abstraction of too much water from the rivers will injure the navigation.

This objection comes mostly from Sind. But here again it should be understood that it cannot be listened to. The waste of water that would be necessitated by keeping up navigation is out of all proportion to its value. It would be like keeping an elephant to draw a go-cart. Navigation on the rivers in the Punjab or Sind is doomed, and it is useless to try and save it. Navigable canals do not answer in North India, and traffic will have to be by railway. At the same time, wood (and perhaps boats) will be able to come down the Indus most likely for a long time while the river is high.

10. *Province to be looked on as a whole.*—Another most important principle which needs to be received is that the province is to be looked at as a whole. Hitherto this has not been done, but each scheme has been looked at independently as complete in itself, and it had to stand or fall on its own merits, apart from its relation to the improvement of the province as a whole.

This has hampered progress much, especially as regards works not charged to "49—Works not chargeable to revenue," to get money for which has been an exceedingly difficult task.

The province can never be properly developed on these lines, and it is most essential that it should be looked at as a whole, and the vested rights of the people as a whole be taken into consideration. Thus the abundance of one part will be used to remedy the deficiency of another, the state of those who have but a precarious subsistence be more regarded and the amelioration thereof not allowed to be prevented by the vested rights of the few who are well off.

This will be further enlarged upon later when dealing with the Western Jumna Canal. The principle is merely enunciated now.

From what was lately said by Mr. Preston on the occasion referred to before, it is understood that the question of giving a more liberal treatment to minor works is before the Government. It is hoped that this matter will be dealt with in a very broad spirit indeed.

11. *General method of dealing with the problem as a whole.* The ground being thus cleared, it is possible to take a general view of the principles to be accepted in dealing with the development of the irrigation of the province (and beyond it) as a whole. It is maintained that these principles are as follows:—

(1) Use if possible all the available water and do not let any be wasted.

(2) Spare no effort to irrigate every bit of land which needs irrigation.

Water is to North-West India what its iron and coal are to England, or what gold is to the Transvaal, but the greater part of the water still runs away unused to the sea, and on the other hand much land lies barren and waste, or exposed to famine, which could be watered. However difficult the problems may seem, they should be boldly attacked until it can be said that practically all the lands that need water have been provided for, and not till then should water be allowed to run unheeded to the sea.

Nor is there anything in these problems which would be so excessively costly that a prosperous and wealthy department like the Irrigation cannot afford to carry them out, and the ultimate result will be the far greater prosperty of the province (or provinces) as a whole, than if a more cautious policy be followed.

12. *The application of these principles.*—Let us now see how these principles would be applied.

Generally speaking, in the north and west there is a plethora of water and (at all events in the Punjab) too little land, while in the south and east there is too little water for the land. We will examine this in detail in connection with each main river, for once we get to any distance from the Himalayas and beyond the fertile belt with good rainfall, high spring level, and many irrigation wells, there is but little water available except in the rivers, though there are exceptional cases which must be dealt with specially, such as the districts of Gurgaon and Gujrat, and other parts. Also it is not proposed in this paper to say anything about the extension of well irrigation, though it must always be borne in mind that it is a most excellent thing for suitable parts of the country, and it should be encouraged in every way.

13. *The Indus.*—Beginning from the north-west corner, the first river is the Indus, with a volume greater than that of all the rest of the Punjab rivers put together.

The Sind Sagar Doab, even if it should all prove on examination to be irrigable, will take but a minor portion of this volume, and in order to prevent the present great waste of water it is necessary that every bit of land in Sind which can be irrigated should be provided for by canals from this vast volume. What the area of the unirrigated land capable of irrigation in Sind is, is not known to the writer, but, however great it is, in all probability there is far more than enough in the Indus, after the Punjab has had all it wants, to water it completely, and the water should therefore be taken to the farthest possible limits, bringing much waste land under cultivation.

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* From what Mr. S. Preston, C.I.E., Chief Engineer, I.B., said lately at the Society of Arts in London, it would appear that something of this sort already contemplated.

A very low estimate indeed of what could be done with the surplus water not required in the Punjab and over and above the present irrigation in Sind would be eight million acres annually, possibly vastly more, but is there the land available? It is feared not.

It is understood that schemes for very large canals with at least one weir across the Indus were at one time proposed in Sind, but that they were rejected on the double ground of interference both with the inundation canals and with navigation."[*]

Now if there is anything in what has been said in this paper, such reasons are quite invalid, and the schemes should be reconsidered, and if they do not include *all* the irrigable land which can be commanded they should be recast to include it all. It is practically certain that there is more than enough water for all irrigable land in Sind.

14. *The Jhelum, the Chenab, and the Ravi.*—It will be best to consider the next three rivers together. There are now three canals from these three rivers, but in the three cases there is a marked disproportion between the available water supplies and the areas commanded.

The Jhelum Canal does not command half the land which the water could irrigate. The head of the canal apparently could not have been put higher up because of hills on the left bank, which reach right to the head of this canal; therefore, though some land is excluded from irrigation which needs irrigation, this was seemingly unavoidable. May be, however, some way of irrigating this land will be one day found when science has further developed. It is a nice problem left to the future.

The whole of the Gujrat district, however, should be carefully gone into on the same lines as those proposed for Gurgaon (see para. 24). This Gujart district sometimes suffers from famine, and needs remedial measures.

Now the surplus Jhelum river water is of comparatively little use to Sind, because, even without it, all land in Sind can be irrigated. If, therefore, it cannot be utilized in the Punjab it will be wasted perpetually.

The Chenab Canal, as already explained, lacks commanded area, and even if a subsidiary canal is made to take up the area left unirrigated because not commanded from the present head, still the Chenab river will have water enough for it without damaging the present canal colonists in the least. They will still be able to do much more irrigation than they were ever guaranteed, and the water will be used more carefully and there will be less fear of exhausting the soil.

When, however, we come to the area between the Ravi and the Sutlej we have a tract considerably greater than can be irrigated (as things are at present) by the Bari Doab Canal.

At present this canal only irrigates to the Lahore district border without entering the Montgomery district, and there are tracts in the Lahore district (if not also in the Amritsar district) to which extensions are needed.

Outside the present scope of this canal the following areas of irrigable land exist:—

	Acres.
High land	830,000
Ravi low land	490,000
Beas (or Sutlej) low land	260,000

Or about one and a half million acres.

No doubt this land should be irrigated, but how?

15. *The Lower Bari Doab Canal Scheme.*—A scheme has been prepared for the irrigation of this plot from the combined Sutlej and Beas rivers, taking off near Ferozepore. This project has been submitted by the Punjab Government to the Government of India, and though not yet approved by the latter, it seems likely to be approved after some modification.

It is, however, pointed out that there is surplus water in the north-west of the Province, more than enough for all possible requirements in the Punjab and Sind combined, some of which must therefore be wasted perpetually; also that the eastern and south parts of the Province are very dry and destitute of water. It is therefore strongly urged that to water the plot in question from the Sutlej is a great mistake, which will be greatly rued in the future if carried out, for it is a retrograde step.[†]

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It is admitted that it is an easier scheme to irrigate this land from the Sutlej, and also that there are difficulties in the alternative scheme. Nevertheless, the ultimate benefits to the country as a whole by the alternative scheme are so much greater than by the scheme as prepared, while the difficulties are far from insuperable, so the Sutlej should certainly not be drawn upon for this project. Let us look at the matter a little more closely.

16. *Alternative scheme.*—The alternative scheme is as follows: make a channel from the Chenab river to the Ravi, and take out a canal from the Ravi to irrigate the Lower Doab. Then, to make up the deficiency in the Chenab supply, make a channel from the Jhelum to the Chenab, and take out a channel from the Chenab to supply the lower part of the Chenab Canal. Aqueducts over these big rivers are out of the question, on account of the expense and the great height to which they would have to be raised to clear the floods, etc.; but the above method of dropping the water into the river and taking it out again presents no such difficulty.

17. *The objections.*—The main objections are two in number:—

(1) the great cost of crossing the drainages, and

(2) the great height above the country of the Bari Doab, as compared with the bed of the Ravi.

It is submitted that these objections are not of great weight, if only the best method of designing the project be adopted.

First, as regards a canal from the Ravi for the Bari Doab, Mr. Preston, speaking at the Society of Arts, spoke of the difference of level between the Ravi bed and the plateau as probably 40 feet.[‡] The writer is doubtful if it can be any like as much, but granted for the sake of argument that it is so, still it will not invalidate the scheme.

In the first place, there is not the least need to begin to irrigate by the new scheme at the Lahore-Montgomery border. The present Bari Doab Canal, of course, ceases to irrigate there *at present*, and it is granted that there must be no hiatus in the irrigation; but there is no difficulty in extending the Bari Doab Canal irrigation further down. The high land is here very narrow (it is wider lower down), and it would be no great matter to carry the Bari Doab Canal irrigation to the town of Montgomery itself if need be. It would mean less than 100,000 more acres of annual irrigation.

Now the average irrigated area on this canal from 1886-87 to 1890-91 was 491,000 acres, and from 1896-97 to 1900-01 it was 746,000, or an increase of over 250,000 acres.

There will be no difficulty, therefore, in improving (enlarging the canal if need be) and extending to the extent stated, even if, in addition, an extra area is taken up in the Lahore district. Put the local officers on their mettle, and it is guaranteed that this will soon be done, without any injustice to the present irrigators.

Now the lower down the Doab the new canal has to begin irrigating the less the difficulty will be.

Suppose the new canal head in the Ravi were somewhere near the tail of the Vahu Escape, then such is the slope of the country towards Multan that the canal would doubtless be able to irrigate by the time it reached the town of Montgomery, which is all that is necessary, and this part of the scheme would not be costly.

18. *The Chenab to Ravi Channel.*—Now as to the channel from the Chenab to the Ravi, all that will be necessary will be to pass the 3,000 cusecs[§] or thereabouts down the main line of the Chenab Canal, then along the Gugaira Branch till it reaches a point opposite the point on the Ravi where that river must be reached, and then make for that point by the shortest route which the circumstances will allow.

As to the main line of the Chenab nothing whatever is required as 3,000 cusecs will be added on, and 3,000 will be also cut off by the new channels which bring in the Jhelum water.

The Gugaira Branch will have to be enlarged to carry the extra 3,000 cusecs (less the volume required for the irrigation at the tail which will be supplied by the new channel, *i.e.*, if the new channel did not stop short of the Gugaira Branch). The absolutely new channel from, say, Buchiana on the Gugaira Branch to the Ravi, will only be 20 miles or so long.

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[*] The ground for saying this was a statement made by Sir H. Evan James, K.C.I.E., late Chief Commissioner of Sind, at the Society of Arts when Mr. Preston read his paper there in April.

[†] The writer is informed that the Honourable Mr. Wilson, Settlement Commissioner, Punjab, urged this same thing before the Famine Commission.

[‡] Unfortunately the map at hand, which was furnished by the Punjab Irrigation Department, lacks levels which would settle this point.

[§] Cusec is a contraction in common use in India for one cubic foot per second.

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In crossing this low land doubtless some drainages will have to be negotiated, but by going low down the Ravi like this the chief difficulty will be obviated. To enter the Ravi opposite Lahore would be very costly; to enter it near Saidwala would be to escape all difficulties of drainage; to enter it at the point suggested would not be costly. The greater part, if not the whole, of the drainage met with would be diverted into the Ravi by a large catch water drain and an embankment behind it to protect the new channel. The small amount of drainage which could not be so dealt with could be made to cross the channel by level crossings where the levels suited, and by syphons where they did not. This could easily be determined by running a trial line in the direction suggested.

19. *The Jhelum to Chenab Channel and continuation.*—This channel to carry, say, 3,000 cusecs, would either be the Jhelum Canal main line and Southern Branch enlarged, or else a separate channel close alongside these channels till it reaches the first great bend on the Southern Branch whence to the Chenab is a short distance of 15 miles or so There would be very little drainage to be encountered. The big drainages would all have joined the Chenab up stream of this. At the junction of this channel with the Chenab another weir would have to be built and a channel be made from that place to take up the irrigation of the Jhang, the Rakh (and possibly of the Gugaira) Branches below the points at which it cut the existing channels. This would of course cross the drainage of the country, but would not meet anything very formidable.

20. *Comparison of cost*—It is not easy to make any comparison of cost between the scheme now before Government (say, scheme No. 1), and that herein proposed (say, scheme No. 2), but the following remarks may be considered.

As to the cost of scheme No. 1, not only should the amount of the proposed project, *i.e.*, Rs. 3,32,00,000 be included, but also the capitalized value of the Sutlej river water. The reason for this is that in scheme No. 1 this water is used up for the Lower Bari Doab, whereas in scheme No. 2 other water which, as has been before shown, must otherwise be utterly wasted in perpetuity, is to be used for this purpose, and the Sutlej water set free to water land which is now desert and will remain desert on the lines of scheme No. 1, but can be made most fertile by means of scheme No. 2, a tract now worth almost nothing, but with a canal to water even one million acres would be worth at least Rs. 10,00,00,000; and the canal could irrigate immensely more than this.

21. *Rough estimate easily made.*—It is therefore strongly urged that a rough estimate of cost of scheme No. 2 be prepared. This can easily be done without sending any European officer into the field by making each of the Superintending Engineers of the Jhelum, Chenab, and Bari Doab Circles do the part in his circle (mainly from existing surveys and the cost of somewhat similar works in the circles). The very few trial lines which are needed for this estimate can be run by native surveyors in a month, and the rough estimate would be ready in three. If further surveys later on revealed possible improvements in the trial lines, then this would all be to the advantage of scheme No. 2.

The different parts of the estimate would be as follows:—

JHELUM CIRCLE.

(1) A channel from the Jhelum to the Chenab to carry 3,000 cusecs on the lines stated above.

CHENAB CIRCLE.

(2) A weir across the Chenab river at junction of above channel with the Chenab.

(3) A channel therefrom to take up the lower irrigation of the Jhang and Rakh branches, and, if necessary, that of the Gugaira Branch also.

(4) An enlargement of the Gugaira Branch to carry 3,000 cusecs more, as far, say, as Buchiana, and a channel from there to the Ravi.

BARI DOAB CIRCLE.

(5) Extension of Bari Doab Canal irrigation to Montgomery Town, including any necessary enlargement of channels.

(6) A canal from the Ravi where the Chenab channel comes in to take up the irrigation of the high land of the Bari Doab below the town of Montgomery and also the Ravi low land which is commanded.

All the new estimating required will be for the Ravi weir and the new channel from the Ravi till it meets the proposed alignment near Montgomery.

The estimate thus obtained will give a fair idea of the cost, and even if it cost 600 lakhs, it would be far better to spend this amount than to waste the beautiful water of the Sutlej on a tract which can get water elsewhere, instead of using it to enrich desert lands desolate for lack of water. As a matter of fact, scheme No. 2 will not cost anything like this; it is far more likely that 400 to 450 lakhs will suffice for it. But let these two schemes be regarded not as mere isolated independent projects, but as part of a great whole for the improvement of the Province. It is believed, then, that No. 2 will undoubtedly be preferred.

22. *Another difficulty.*—If, however, scheme No. 2 should be approved, what would be done with the water of the Sutlej thus saved?

This leads us to another difficulty. There is, undoubtedly, land available on the left bank of the Sutlej, but only a very small proportion of it is in British territory. Some of it would be in the Bikanir State, but the mass would be in the Bahawalpur State.

This is a drawback, but on the principle of developing the whole country it should be accepted that these lands should obtain the water. Nevertheless, it is most important that certain conditions should be laid down and adhered to in the matter, as the ground upon which alone the British Government will consent to forego the use of the water of the Sutlej on the right bank thereof, and put itself to great extra expense in so doing.

Canals partly worked by the Native States present intolerable difficulties, only to be realised by those who, like the writer, have experienced them.

Therefore, the following conditions should be insisted on:—

(1) The canal to be British, and constructed with British capital only, and worked and maintained by the British, just as the Abohar and Bhattinda branches of the Sirhind Canal are worked.

(2) The British Government to fix the rates to be charged as it thinks fit.

(These rates will be doubtless higher than on the Sirhind Canal, seeing the immense value of the water in such a rainless tract, and the great cost involved by this scheme, and the other schemes necessitated by this one.)

(3) Proper arrangements to be made on a plan worked out by the British Government for supplying the necessary population for the cultivation of the land which will be irrigated, but which is now nearly uninhabited.

The Native States will gladly consent to these terms if they understand that only thus can they get the water, and no matter what is done, or however high the rates fixed may be, the gain to the States, especially to Bahawalpur, will be stupendous, just as the gain has been to Faridkot through the Sirhind Canal.

Of course the weir across the Sutlej would make a provision for the supply of the inundation canals on the right bank, which are supplied at present from that river. The objection to the use of the Sutlej water to the high land on right bank would not apply to this low land, for these canals will only require water when there is extra water in the river.

As to the proposed canal on the left bank, it should be designed to command five million acres, for it will be able to irrigate nearly two million acres, and there should be room for expansion as the duties of the water are improved. It may, however, possibly be better to make two or more smaller canals instead of one huge one. Almost all the land embraced by such schemes is now practically desert land.

23. *The Sirhind Canal.*—As regards the Sirhind Canal, it gives the fullest protection to its commanded area, *viz.*, to the Ludhiana and Ferozepore districts, and the main portions of the Patiala, Jhind, Nabha, and Faridkot States.

Unfortunately, the canal partly belongs to the Native States, and this causes complications, otherwise it would be proposed to extend the irrigation from the Kotla and Ghaggar branches into the Sirsa Tahsil of the Hissar district, but apparently the treaties with the States prevent this being done, which is a pity.

24. *The country between the Ghaggar and Jumna.*—The Sirhind Canal irrigates up to the edge of the Ghaggar river, and we will now consider the case of the country between the Ghaggar and the Jumna. It is this tract which contains almost the whole of

Punjab, which is subject to famines, and the amelioration of its condition is perhaps the most urgent question of all.

The Western Jumna Canal irrigates much of this tract, and is invaluable. But even with this canal there is a great deal that is sadly needed for the improvement of this part of the country, and many difficult problems have to be solved.

The tract in question embraces the six districts of Umballa, Karnal, Delhi, Gurgaon, Rohtak, and Hissar, and parts of Patiala, Jhind, and Nabha States.

Its first desideratum is that it should be secured against famine; the second that its general condition should be improved.

The Umballa district has the best rainfall and many wells, and is already secured; therefore nothing need be said about it, except that what will be said with regard to the torrents in dealing with the Karnal district, will apply in measure to Umballa.

The Delhi district is so well irrigated by the Western Jumna Canal, besides having a better rainfall than the rest, that it, too, may be looked at as secure.

25. *Gurgaon district.*—The Gurgaon district must be treated by itself. It cannot be dealt with from the outside.

It has already a system of rough but fairly effective irrigation works belonging to the district. What is wanted is that this system should be much improved and extended, and money should be freely furnished for this purpose. It should not be expected that these works will furnish a large return for the expenditure, and the district has not capital enough for the purpose.

Mr. Macgregor, the District Engineer, is fully capable of drawing up a thorough scheme for the protection and prosperity of the district, and with the help of a subsidy from Government, and money lent on easy terms, this district can be thoroughly secured, and made to flourish in a high degree.

26. *Western Jumna Canal.*—For the rest we must look mainly to the Western Jumna Canal.

This canal has a curiously chequered history, and, while the oldest, it is far the most backward of all the Punjab canals. It has been patched and repatched, a bit new here and a bit new there, but always tacked on to the old, and therefore never what it should be. This old canal of the Moguls had every defect a canal could have, and though vastly improved, is very different to a properly constructed and designed canal. The Government system of accounts hits this canal very hard. The nominal capital account is about 180 lakhs of rupees, though half the canal is still in its primitive condition. The cost of, say, patches No. 1, No. 2, and No. 3 is all charged to the canal capital, though Nos. 1 and 2 have long been superseded; and a brand new canal could have been made for the amount of the present capital. Any commercial business would have carried out the improvements by means of a sinking fund or redeemable debentures, and left the capital small. Even now it would be far better for a large portion of the capital to be written off against surplus profits, which were so large in the old days, going back say about 50 years, and altering the accounts accordingly.*

It may be said that it is only a question of accounts, and it does not matter. But it does matter, for the overloading of the capital account has a bad effect on the improvement of the canal.

27. *Peculiar conditions.*—What adds to the difficulty of the problems connected with this canal is that the seasons are so unequal at different periods. Thus from 1870-71 to 1894-95, a period of 25 years, there were only two very dry years, *viz.*, 1877-78 and 1883-84, and very few even fairly dry ones. Most of the years were wet; that is, over the area embraced by the old unextended canal.

Since then there have been seven years of drought or famine, occurring one after the other. This greatly increases the difficulty of dealing with the circumstances. In the first half of the last decade (1890-1900) the cry went up all over the canal—"We do not want your water, we only want drains." In the latter half—"Why these drains?—We only want water."

Unfortunately the last extensions were only just being carried out when the drought began. Had they been finished a few years before the drought, the irrigation would automatically have shifted its centre from the wetter tracts traversed by the old canal, where year after year the demand for water was so slight, to the new and drier tracts of the extensions. If after that the drought had occurred, the relief at famine time would have been far greater than it was (though the famine would have been very much *worse* but for these extensions).

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28. *Hissar district.*—The famine fell with far the greatest severity on the large Hissar district (as big as Yorkshire), where the distress was greater than in all the rest of the Punjab put together.

This district has five tahsils, and there is some irrigation in all of them, but irrigation from the late extensions at the tail of the Sirsa Branch from the Hansi Branch and from the Bhiwani distributary, were not fully developed, for the reason given above, for owing to the great demand for water on the one hand and the frequent cutting of the banks on the other (this was worst on the Bhiwani distributary), it was very difficult to get water to the tails. No doubt something is being done now in this direction, but directly the old order of seasons returns, it will be possible to work up these extensions to a thorough state of efficiency and bring out their full value. Besides this, it is necessary that the rest of the land under command in the Hissar district (leaving out that part which is altogether too sandy) should also be taken up for irrigation. This area is not vast, but if it is irrigated and *the former extensions fully developed*, there can be no famine in Hissar and no great scarcity. The situation would be saved.

The chief unirrigated and irrigable tract is the one which would have to be reached through the Jhind territory from the Butana Branch, which must be enlarged. On no account, however, should this distributary be made until the Jhind Durbar consents to the condition that it should be wholly a British channel and all the irrigation be looked after by British officials, and a consolidated rate be charged for the water, equal to the combined rates paid on British territory.

Even on these conditions the benefit to the State would be so very great that directly it is seen by the Durbar that it must accept the conditions or the channel will not be made, immediate consent will be given These conditions are those made with Faridkot on the Sirhind Canal. On no account should any other arrangement be made with the Jhind or any other State, such as the former one made on the Western Jumna Canal, which makes the proper working of the canal impossible It is like trying to walk fast with a stiff knee cap. It was all right in old days when there was more water than could be used; it is an anomaly and a blot in these days of economy of water.

There is some other land to the south of the new Petwar distributary which should be taken up, and this would appear to be all, except an important part of the Hissar district near Barwala, between the Pabra and Mahsudpur distributaries, but unfortunately this cannot be irrigated without upsetting the arrangements with the Patiala State as to irrigation from the Sirsa Branch. These territorial arrangements are heart-breaking, and canals should be like railways, independent of these differences.

The canal officers should be encouraged to work up the irrigation in Hissar to the utmost. It is much easier to irrigate near the heads of channels than at the tails, especially when, as here, the channels are very long, but it is essential that the water should be pushed down to the extremities. The Bhiwani Tahsil of the Hissar district has practically had no irigation as yet from the Bhiwani distributary.

Every bit of the Hissar district which can be commanded, and is not altogether too sandy, should be irrigated and get its share of water, wheather fron the Western Jumna Canal or otherwise. Some of thes other portions of the district will be mentioned later and the question of how this can best be done wil be discussed.

29. *Rohtak district.*—The Rohtak district is perhaps the next worst district to Hissar, though after long interval.

The Gohana Tahsil is well irrigated. The sampl and Rohtak Tahsil are both irrigated, and when th irrigation on the Bhalot and Bhiwani distributaries especially the latter, is developed, then these tw tahsils will also be secured, and the Jhajjar Tahsi will be the only one left to be troubled with famine

This is not an easy matter to remedy. The lan is almost all too high to be watered by the canal The writer has not sufficient local knowledge to sa how this problem can best be solved, but probably i can be done in connection with the drainages whic run into the Najafgarh Jhil, including drain No. 8 Lack of knowledge of details precludes more bein

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* It is on this same principle that a Government building is supposed to get more and more valuable the older it gets, and the higher is the ren charged for it. A remarkable instance of this was the head-quarter bungalow, of the Karnal Division at Dadapur, just before the transfer of the division office to Karnal. This bungalow, when so old and rotten that it hardly held together and leaked like a sieve, was charged for at a higher rat than ever before.

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said, but with the rest of the district secured, scarcity in the Jhajjhar Tahsil cannot be bad, but certainly remedial measures are possible here also.

30. *Native States in South-East Punjab.*—There are portions of the Patiala, Jhind, and Nabha States in the extreme south-east corner of the Punjab. These suffered greatly in the recent famines. The country here is very like that of the Gurgaon district alongside, and it can be treated in just the same way by local irrigation works and the damming up of torrents.

31. *Karnal district.* The greater part of the Karnal district is thoroughly protected by the Western Jumna Canal. Some portions of the distributary system, especially the Nardak distributary and Chautang scheme, need developing, like those in Hissar, but when this is done the greater part of Karnal will be quite raised above fear even of scarcity.

The other part outside the scope of the Western Jumna Canal proper will be separately considered.

32. *Suggestions as to arrangements for the above proposals.* It will naturally be inquired whence the water is to come from to carry out the above.

It is not proposed to attempt a final answer to this question, but some suggestions as to the way in which the solution can be gained may be mentioned.

Unfortunately the Jumna river does not lend itself to canal extension as well as the other Punjab rivers, for it rises more tardily in the spring (a great defect), and generally falls more quickly in the autumn. Therefore, while something might be gained by carrying larger supplies when available, yet the gain would be less than on other canals.

The first thing to be done is to improve all the internal arrangements. Much, very much, has been done, and is being done, but much remains to be done The old irrigators are the worst offenders. Their water-courses must be made straight, and must be well kept, and the land must be divided up into the proper plots (*kiaris*). The cumbersome and troublesome rules on the subject must be amended, and it must be made clear to everyone concerned that the necessary divisions *must* be made, or the water will be cut off. The question is of such importance that it must be approached in a thorough and systematic manner with insistence. The water saved by this reformation will be a distinct step to the gaining of the end in view. Together with this, the standard of maintenance must be raised still higher, the channels be better kept even than now, and the expense of this high standard must not be grudged It must be borne in mind that on a defective canal like this the cost of maintenance must be much higher than on well-designed canals.*

With the above there should be a great rise in the rates for sugarcane. It is the waterings for the cane which so stand in the way of the developments imperiously needed.

The combined rates for sugarcane should be raised from Rs. 9 per acre, as at present, to at least Rs. 18. The result will then either be that little cane will be grown, in which case the problem would be solved at once (there would be ample water for all that is wanted), or else and this is far more likely, the area of cane will be much as before (this is the conclusion come to after careful inquiry), but the revenue will be increased by four or five lakhs of rupees per annum, and this, though not so efficacious as the alternative, would go far towards solving the question in other ways.

It must be remembered that until the recent drought occurred, much land of the Delhi and Karnal districts suffered from over-irrigation. These parts were under medical supervision because of their unhealthiness. The spring level was very high, less than ten feet from the surface, and the land was impoverished. This was in spite of the marked improvement effected by the drainage schemes before alluded to.

The extensions of the canal on the one hand and the seven years' drought on the other have been the greatest blessing to these over-irrigated parts. They could not get the same water as before because of the great demand, and much less rain fell. The consequence is that these parts have marvellously improved in tone, in health, and fertility by the very cause which brought such suffering elsewhere. The spring level, too, though still very high, has fallen.

It is to be hoped that this improvement will be maintained and even increased, and that on no account will these tracts be allowed to revert to their old condition. The people here should pay well for the water, especially for the cane, and pressure should be put on the people to irrigate by wells where the spring level is less than 15 feet from the surface. The amount of irrigation allowed in such tracts should be strictly limited, and it should not be allowed at all where the level is within 10 feet of the surface.

Thus the reproach caused by the unhealthiness brought about by the irrigation of this canal would be completely wiped out, while the water saved would go to enrich tracts which so much need it.

33 *Further suggestions.*—It is believed that by the above methods there will be no difficulty experienced in getting sufficient water to completely develop all the later extensions on the Western Jumna Canal, and also to irrigate all the tracts still unirrigated, but potentially commanded by this canal.

Then famine should be for the Punjab a thing of the past, and a measure of scarcity over a very reduced area be the worst to be feared.

It should be insisted on that the matter be fully taken in hand at once, as one of the deepest importance. Prevention is much better than cure.

Once it is understood that the thing must be done, impossibilities will vanish.

If, however, it be still urged that there is no water, which is really a vain plea, then another suggestion is put forth as follows :—

There is a most rapid fall between Taiawala and Dadapur at the head of this canal, and any required amount of power is available.

The canal, in its upper reaches especially, passes through a water-logged spongy soil, saturated with water, which in places, as above Indri, comes to the very surface of the ground.

There is no engineering difficulty in converting the power into electricity, and pumping up the water from the saturated soil and adding several hundred cubic feet a second to the discharge of the canal if need be, and returning the water to the soil in the flood season to be again pumped up.

This scheme would, however, be very costly, especially because of this, that there would be so many years normally wet, when extra water would not be required. The scheme is merely put forth as an alternative in case the first suggestions (which the writer is assured are all that is needed) are objected to

The great thing is to get the water to the parts which need it so much instead of lavishing it where but little needed and even where it may do harm Once the normal character of the seasons is reverted to all will come right as to the widest extensions, if the canal be properly worked.

34. *A lost opportunity.*—What a splendid opportunity was lost when the Western Jumna Canal was remodelled in the seventies, to have taken up the whole commanded area in a thorough manner. Such an opportunity can never come again, and the canal must now be a makeshift with many bad mistakes to the end of the chapter, but the minor extensions here proposed in addition to the major ones that have been carried out, in the last ten years or so, will do much to wipe out the reproach of the past and completely change the old order of things, in which the parts which wanted the water least got the most, and those which wanted it most got none.

35. *The tract between the Western Jumna irrigation and the Ghaggar.*—There is still one more tract of land to be discussed, and that is the tract between the Western Jumna irrigated area and the Ghaggar, including the tract at the lower part of the Ghaggar, where the Ghaggar Canals are situated.

This is a tract seamed in its upper portion by great torrents, which all eventually unite and find their way into the Ghaggar river. This tract is not in a flourishing condition. It is sometimes inundated and at other times suffers from drought.

The torrents have often been obstructed in a most unscientific way for rude irrigation, with the result of injured health, blocked drainages, and general impoverishment of the country.

What is wanted is a clear waterway for the floods and some arrangement for supplementing the water supply in times of drought.

In this portion are the Sarusti District Canal (Karnal), the Rangoi District Canal (Hissar), the Ghaggar Canals (Imperial). None of these have worked to any extent in these late years of drought, and this bit of country wants thorough consideration.

It is believed that it is possible to put this tract into thoroughly good order, but it will be expensive,

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* This is another argument for the reduction of the capital cost of this canal, which has before been alluded to.

Doubtless the importance of the question in the broadest sense was not understood, but the Irrigation Department would have done the work in a far thorough manner had its officers been allowed to do it as they wished.

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and the scheme must not be expected to be remunerative in a pecuniary sense, but indirectly it will be very advantageous and remunerative.

36. *Proposals.*—All obstructions should be taken from the torrents. If irrigation is to be done from them at all, it should be by means of proper channels taking out above properly constructed but cheap regulators, under the control of those who will work them properly, and the channels must be re-dug where blocked, and parts must be straightened.

The Sarusti Canal is a thoroughly sound one in its conception, but it was marred for lack of funds. Even as it is, it will work fairly well in normal years, but it will fail in bad years like the recent ones.

What is wanted is an embankment at the lower end of the lake from which the canal takes out, with a masonry regulator (a needle weir perhaps the best) in the centre of it, so that the lake may be much enlarged and deepened, and the canal made much more efficient. This will be a great improvement, and the canal be much more workable.

It can, however, be still further improved. There are at least three months in the year in which there is spare water in the Jumna river.

There is a torrent just above Dadapur, into which spare water can be forced, and this water will then, partly by existing channels enlarged, and partly by new cuts, combined with suitable regulators, find its way into the Sarusti torrent, and feed the lake from which the Sarusti Canal takes off (a part being taken if needed for the Chautang scheme).

Three months' supply can be counted on, and this is sufficient to make these canals work fairly (with less they can do but little, and only grow a very coarse rice), and if in the Karnal district irrigation wells were also constructed to work with the canals, as is done on tracts irrigated by inundation canals in general, this tract would be most flourishing. Also it will then be possible for the canal to be prolonged through a barren part of the Patiala State into the Hissar district near Tohana, and water a very needy portion of the Fatiabad Tahsil, etc., that between the Sirsa Branch and the Rangoi Canal, and it would thus be invaluable for the famine protection of Hissar.

Let it be said as a rough approximation that the Sarusti Canal be enlarged to carry 1,200 cusecs, of which 350 be used in Hissar, 200 in Patiala, and 450 in Karnal, the rest being absorbed. This would thoroughly secure this tract, which needs a double treatment, *viz.*, proper control of the torrents and water for times of drought.

The channel out of the head channel above Dadapur could be made to carry 2,000 to 2,200 cusecs; the surplus would be carried on through the outfall below the head of the Sarusti Canal into the Ghaggar river, and by means thereof the Ghaggar Canals would be able to work satisfactorily, and the Rangoi Canal prospects would be secured These canals all irrigate the thirsty Hissar district, and will thus do much to raise it above all scarcity.

37. *Further proposals.*—This scheme would not be directly remunerative, but it would be of great service. It is one which in its design and construction, and also in its maintenance, should be entirely in the hands of the Irrigation Department, for if badly designed or worked, it would do great damage. The two railways also which are crossed would require assurance as to the maximum volumes of water they might have passing their lines; they will, doubtless, need to strengthen their bridges, and to be repaid for doing so. Proper regulations would be required to ensure correct working, and great promptness would also be needed to shut off all extra water when the torrents were flowing full. Then, again, as the canal would water two districts and a native state, therefore district authorities would not be able to work it.

N.B. The whole canal should be under one management only, not partly British, partly native state. This latter arrangement is fatal to all good work economy of maintenance, and efficiency of every kind.

38. *Completion of the sketch.*—This completes the sketch of the requirements of the Punjab (and Sind), with a view to the best use of the available water-supply, the prosperity of the province as a whole, the prevention of famine, and even of scarcity.

Before ending, however, it is desired to call attention to three matters of great importance.

39. *Maintenance of canals.*—The question of the maintenance of canals has been mentioned in connection with the Western Jumna Canal, but everywhere, greatly as the standard of maintenance has risen of late years, there is the greatest need of raising it much higher.

It must be understood that to have every channel in perfect order is not a matter of eyewash, but that it means economy of water. Every irregularity, every hole or unevenness, every unnecessary bend and twist, every unnecessary length in reaching any goal, means loss of water more valuable than gold.

Money for maintenance has been far too grudgingly accorded. *Give money for this ungrudgingly.* It will return doubled and trebled; and not only so, but the less the absorption the less the fear of injury to the soil. All Government channels must be beautifully kept, and the cultivators must be made to understand that they must keep theirs beautifully too. The old crooked water-courses must be relegated to the past; the old ones must be remodelled, the new ones must be aligned by competent officials, and properly dug from the start; the fields must be properly divided up according to the regulations, which, alas, have been but little observed, and thus, step by step, the old order brought nearer perfection.

10. *Differential rates.*—It will hardly be disputed by any who have a thorough knowledge of the subject that the returns obtained for the water used for irrigation are exceedingly inadequate.

This is seen by the extraordinary enhancement in the value of the land when it becomes irrigable. That the value should be enhanced is intelligible enough, and quite right, but the value is not only doubled and trebled, but sometimes twenty-fold what it was before.

It is often stated that the condition of the peasantry on the new canals is very satisfactory. This is true, but it is the condition of the peasantry in the unirrigated lands which should be more seen to, and the abundance of the holders of irrigated land should go in greater proportion than it does to the less fortunate, so that their lot may be ameliorated.

Some expensive and some unremunerative schemes have been mentioned as necessary, and there is every reason to urge why the fortunate possessors of land on permanent canals should bear the burden thereof.

The difficulty of getting adequate returns doubtless lies in the differences of the soil.

On the average the rates charged are considerably too low, but for some soils they are as much as can be borne, possibly too high in a few cases. On the other hand, there are soils and crops which could well pay vastly more than they do, and still make splendid returns.

It is suggested that the better kinds of produce might pay more in proportion to the poorer kinds; sugarcane pays absurdly low rates, while there might well be a greater difference between the rates for wheat and for barley than there is, and so on. The great desideratum, however, seems to be that just as there are differential rates for different classes of crops, so there should be for classes of soil.*

As in the settlement of a district the various kinds of land are classified and revenue rates fixed accordingly, there would be no difficulty in arriving at the necessary conclusions to enable differential rates to be fixed.

Difficulties doubtless there would be, and possibly new legislation required, but it would be a great thing to overcome these difficulties and to get a return for the water supplied which would be a closer approximation of its real value than now obtains.

Who can doubt that if people were allowed to acquire rights in the water and to sell it, that they would charge far more (double or treble) than is charged now.

There was a case of this sort where a European named Staines acquired a water-course on the Western Jumma Canal, near Rohtak, with certain rights, and for years he made large profits by selling the water at very high prices, and a large sum was eventually paid him, as compensation for his loss (when he could no longer do this) by order of the Lieutenant-Governor.

41. *Establishment.*—One other matter will be mentioned, and that is the question of the establishment, and in a way it is the most important of all.

An officer giving evidence before the Famine Commission asked to be allowed to speak on this point, but was told it was barred by the constitution of the Commission. Nevertheless an Irrigation Department in the highest possible state of efficiency is the best possible preventive against famine.

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* This is not an original idea, but it is a very good one.

Mr. S. L. Jacob.

Work up the Irrigation Department, give to it much larger scope than at present, throw the onus of preventing famine on the officers thereof, let this be looked at as a chief duty of the department, and it will do more than anything else to avert famine.

The Irrigation Department has vastly expanded of late years, and must expand much more, but the establishment of the Irrigation Department has been little cared for, discontent rules, and the service is most unpopular This can easily be proved. Ask for volunteers from the Irrigation Department for the Railways or for the Buildings and Roads Branch, and many will respond at once. Ask for volunteers from the Railways or Buildings and Roads Branch for Irrigation, and not one will come forward This is not a theory; it is a fact, for it has been tried.

This ought not to be. There is nothing material that can benefit India as much as irrigation, and there is no branch of engineering which presents so many difficulties and contains so many problems to be solved.

Moreover, there is one matter in this connection which has not received sufficient attention. This is as follows.—In other branches of engineering the Indian engineers enter into the labours of myriads of European engineers, who are ever engaged in solving the various difficulties that arise, but in Irrigation the engineers are pioneers, having to work out their own problems, and others enter into their labours, as in the case of Egypt.

Surely this is reason enough for seeking the highest class of men for this work—men who are observant, who, not content just to plod along, carefully study the various difficult problems which meet them in their work, full of enthusiasm, who understand that there are immense possibilities in this field if the subject be mastered.

To get men of this class, it is worth while to pay highly, and nothing is more costly than to get inferior men for such complicated and delicate work as this is.

Entry into the department should be looked at as a prize; and when officers prefer, as they do, the matter of fact Buildings and Roads Branch to the Irrigation Branch with its fascinating problems, it shows that there is something wrong.

It is not meant that there are not able men in the department; there are several who could be named of very high ability, while the department as a whole is extremely hard working, being in a way forced into hard work, because in the lonely life led there is so little else to do. Nevertheless, the present method pursued is not the way to secure men up to the required standard. The loneliness, the laborious character of the work, and the fact that he who would excel therein must cut himself off from the pleasures of Society, and spend most of his time in camp, hot weather and cold, in a way which is not at all necessary with other engineers, should be borne in mind.

The jungle allowance was a step in the right direction, but a more generous treatment by far is necessary if the department is to reach and maintain the high standard of efficiency which is so desirable.

When, particularly, we look at the officers on whom so much of the burden of the work falls, *i.e.*, on the sub-divisional officers what do we see? A most heterogeneous mass Imperial engineers; provincial engineers; temporary engineers picked up anyhow and treated as aliens; subordinates of all sorts; and even zilladars holding sub-divisions. The confusion is terrible. How can a proper standard be gained under these circumstances? The matter has been reported and referred by the Local Government often enough, but no real reformation has been attempted.

The matter needs to be taken up thoroughly. The Irrigation Department wants to be treated in a most generous manner in accordance with the exigencies of the case as a department *sui generis*, just as the railways are treated; and as Irrigation officers labour under so many disadvantages in some ways which cannot be remedied, these should be made up to them by extra pay and increased advantages in other directions as a compensation, so that entry into the department may be as much desired as now it is dreaded.

It is earnestly hoped, however, that no such remedy will be proposed as to make the irrigation officials simply engineers, while all the rest of the work is done by revenue officials. This would be to damage the department more than anything else could do. It would take all the heart out of the engineers. They would no longer be able to work for results as they now do. The engineering work would sink into dry routine, and the many complicated problems which now engage the minds of the thoughtful among them would no longer engage their attention. There are undoubted defects, but this certainly is not the remedy.

The higher revenue officials engaged in the work would never make this work their life study as the engineer has to do. It would merely be an episode of many in their lives. The Civil Servant would take it up no doubt in good earnest and do his best, but the post would only be a stepping-stone to a higher appointment of a different kind. How could he take up the questions involved as those do who have but this one matter to engage their attention. It is not a question of the ability of the two classes, but of whether efficiency can be obtained on any subject by men who can give but minor attention to that subject

42. *Summary.* It now remains to give a brief summary of the contents of this paper:—

(1) Let the possibilities of the future be read in the light of the progress in the past.

(2) Let there be greater boldness in attacking the problems to be solved, and let these be taken up in a broader manner than has yet been done.

(3) Inundation canals must be supplied from weirs; navigation must not be considered.

(4) Use every drop of available water as far as possible, even if cheaper schemes can be designed which entail waste of water.

(5) Every bit of land which needs water to be irrigated if possible, even if the schemes be costly.

(6) Famine to be looked at as a blot and anomaly, and thoroughly combatted, money being freely given even to unremunerative schemes for this purpose.

(7) The Indus water to be more fully utilized in Sind as well as in the Punjab.

(8) The Jhelum, Chenab, and Ravi water to irrigate up to the right bank of the Sutlej (except the Sutlej low lands).

(9) The Beas-cum-Sutlej water to be utilized on the left bank thereof.

(10) The tract between the Ghaggar and the Jumna to be more fully irrigated, each part being dealt with on its own merits. No tracts commanded by the Western Jumna Canal to be left without irrigation.

(11) A higher standard of maintenance to be adopted and more money spent thereon.

(12) Differential rates for soils to be adopted, as well as higher rates for high class crops.

(13) The establishment to be remodelled and dealt with more generously, as for a department by itself.

43. *Final remark.*—It is believed that the proposals made herein will not only conduce to the better development of the Province as a whole than anything yet proposed, but that they will even be the best indirect pecuniary results, taking these over a series of 30 or 40 years.

Mr. H. C. Fanshawe.

Memorandum prepared by H. C. Fanshawe, Esq., C.S.I., late Commissioner of the Delhi Division.

The questions in the memorandum of points to be considered by the Irrigation Commission in the Punjab are so very general and wide that until the data needed under each are before one it is difficult to offer any useful opinion upon them. I make, however, a few suggestions on certain points.

Head 4.—It is impossible that much should be done by District Funds to construct irrigation works such as the *bunds* in the Aravalli ridge in Gurgaon and Delhi. Even what has been done has probably been the cause of injustice to estates not benefiting from these works which have received no special benefits from their annual contribution to

Local Funds. The work of making these *bunds* should, I consider, be seriously taken up by Government, a certain number of the works being reserved in Famine Relief Work Programmes for famine times. If the development is really well pushed on, the works will probably have to come finally under the direct control of Government, as they will be beyond the management of a District Board; that is, the Deputy Commissioner, and a Mr. MacGregor is not to be found usually to do the work which this officer has done in Gurgaon.

Head 6.—The villages for which *bunds* will be provided should be required to take money and sink wells below and above the *bunds*, as should villages to which canal irrigation may be extended hereafter. Our terms for wells are quite easy enough, I believe. What is needed is a simple method of distribution of the *takavi*, as was done with *takavi* for seed and oxen in 1897 and 1900, and the saving of the loan, taken from constant visits to the tahsils or to officials. Our Tahsildars simply will not give sympathetic help to the people in these ways unless compelled to do so, and they must be compelled. Much of the actual giving of advances should be done by the Revenue Extra Assistant Commissioner and other higher Revenue Officers.

Head 8.—The smaller village tanks made in 1896 have no doubt been of value to the village in which they were made, but nothing will prevent these tanks from ordinarily drying in the autumn of years in which the summer rains fail. Our large tanks of 1900 have not had a fair chance yet, but I believe they will prove of considerable value in the course of time. The proper connection between them and the surrounding lands and drainage lines was not even generally made in 1900, though I drew special attention to the point, and should be certainly made now. Canal cuts should also be made to these tanks, so that they may be filled up and be subjected to a natural course of puddling when the canal has really spare water, which is every now and again the case. Many more village tanks on the outskirts of the area of canal irrigation ought, I think, to be connected with canals, and be filled as far as possible without payment in seasons of drought. There is no way in which we can more thoroughly show our sympathy with the people than this, and our rules should provide for this. At present Canal Officers are, I understand, unduly hampered by their rules in this connection, and the possibility as well as the favourable moment for filling tanks passes away while correspondence is going on between the Deputy Commissioner and Executive Engineer. We must of course duly consider the interests of irrigators in seasons of drought; but it ought, I think, to be a feature of our system that in such seasons irrigators must be somewhat stinted and non-irrigators who are without water for their cattle and often for themselves shall share to some degree in the benefits of canals. The necessary cuts to the village tanks might be made as village relief works.

Men from Rohtak have been telling me the old story again now: all the canal water available used for sugarcane and cotton, and these crops largely failures as they must generally be when they do not get the benefit of fair rains. If we cannot forbid such crops, can we not at least arrange that in years of failure of rain canal water will be given to grain crops in preference, and that these specially thirsty crops will be allowed to wither, the cultivators of such crops having to run their risk of this and being of course relieved from paying water-rates or full water-rates on the crops? In case of such withdrawal or stinting of water *barani* fields should be linked up beforehand with the canal cuts, so that water could at once be turned on to them when it is withdrawn from the sugarcane and cotton fields.

Memorandum by H. C. Fanshawe, Esq., C.S.I., late Commissioner of the Delhi Division.

I should be glad if the correspondence regarding the prohibition of certain crops on canal-irrigated lands on the Western Branches of the Western Jumna Canal in the Hissar and Rohtak districts could be submitted to the special Irrigation Commission which is to meet this cold weather. (I would beg to note here that this correspondence, which I forwarded in the early stage to the Financial Commissioner for information, was disposed of without the final opinion of myself or the opinions of the Deputy Commissioners of the above districts being before the Financial Commissioner or Government, which was perhaps a somewhat unusual course to adopt, especially as I had been myself Settlement Officer in one of the above districts, and that I should certainly have had a good deal to urge against the merely economic argument upon which so far as I recollect the question was decided.) I am convinced myself from my experience as Settlement Officer of Rohtak (it will be found in the records of the Irrigation Department that for many years after I ceased to be Settlement Officer I continued to press the needs of that district for further canal irrigation, which has been greatly extended since 1880, but which still stops short of the west of the Rohtak Tahsil and of the Jhajjar Tahsil, the two portions of the district most liable to famine), and as Commissioner of Delhi during the late famine that we ought to still withdraw a large amount of water from tracts with a more favourable rainfall in order to extend irrigation to tracts liable to famine. This no doubt requires to be done with some discretion, and the withdrawal should be supplemented by large grants of *takavi* for the construction of wells, such advances if desirable being made free of charge of interest. Similarly, the extension of irrigation should be made conditional, as has been the case in Mamdot and Bahawalpur, upon a certain number of irrigation wells being gradually sunk by the villages to which canal irrigation is extended. Where the water level is at present very deep—it is not so even now in most parts of Jhajjar—it will rise 40-50 feet in the course of a number of years; there were in 1875-1879 many wells in the Rohtak canal-irrigated tracts 60-70 feet deep in which the water level was only 20-25 feet below the surface of the ground. I am certain that a *very great deal* can be done on the above lines to ward off famine, and mitigate it, and the question ought to be gone thoroughly into from a broad point of view. When famine with its dreadful realities is with us, we all feel that we would allow nothing to stand in our way in effecting anything reasonably practical in the above direction; but as soon as famine is over and its cost is once booked, financial considerations and departmental ideas reassert their stern sway. But I venture to think that this is a narrow and wrong view, and that we are bound to provide against famine in every possible way, even at the cost of reducing past revenue and of making remunerative projects less remunerative than they have been in the past. The unsettling which is caused by famine to the villagers even if actual demoralisation is avoided, the losses from death and sickness, the ruinous destruction of cattle, the abnormal strain which famine imposes on all officers, in not a few cases to the permanent detriment of health and energies, if not to actual loss by early retirement or death, are grounds which clearly ought not merely to outweigh mere financial considerations, but which justify fresh expenditure not directly productive no doubt, but productive fifty-fold in what it saves financially, administratively, and morally in keeping off famine. It is extremely difficult no doubt for officers to fully realize that protection against famine like other things which occur periodically only,—this was once the case with our land revenue record and settlement,—is an essential part of our scheme of administration, and must be steadily borne in view as such, and so far it has nearly always been the case that our after-famine good resolutions in the above direction have come to very little, or even nothing. But our late experiences, and I fear a possible further, though I trust very limited, experience, warn us that this must no longer be the case, and that we must take stock *de novo* of the whole position, and must be prepared even to give up present income to a limited extent if thereby we can provide against famine or reduce the area of its operation.

Mr. H. C. Fanshawe.

The Government of India Resolution has specifically dealt with the case of protective works which may not be considered directly remunerative, and in this connection I need only refer to the schemes of canalising the Siwalik Hill torrents. These works can probably never be paying works, but a great deal could, I feel sure, be done to utilize water in these streams, and especially in the Ghaggar, Markanda, and Sarsuti, which now goes to waste, and which in conjunction with wells might do much good in local tracts. The conjunction with wells is specially incumbent in this case as the rains might fail again in the hills from which the streams issue as well as in the plains as they did in 1900, though I should hope that this aggravated form of calamity would not recur again for many years to come. It must be remembered also that these works would necessarily have a widespread sanitary effect, and this should also be taken into account in judging of their merits. At any rate, if they will produce a certain amount of definite good, the schemes should be got ready and be approved as relief works, and should be taken up as such works when distress next unhappily calls for the opening of these, sufferers from famine being drafted on to them from outside the local limits of the works. The matter is a large one to tackle, but should be resolutely tackled by a really competent officer, who should understand clearly on what lines he is to work as regards financial and protective considerations. It would take probably 18 months to work out with a large and

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competent staff of surveyors. No political considerations should be allowed to stand in the way of the scheme. It cannot be very difficult to find out what the average area in our Native States benefited by these streams has substantially been and to make good to the States concerned as much water as they have benefited from in the past. A stream like the Ghaggar would in South India be "bunded" at frequent intervals and made to yield its flood waters to lands now dry, and there is no valid reason why this should not be done now, the claims of existing projects being duly weighed and secured. What has to be achieved in this instance is to utilize water which now goes mainly to waste—not to withdraw water from one spot where it is usefully employed in favour of another spot.

There is one more point which I would notice. I was not able to go into the question myself on the spot, but from what I could see and hear the tendency of late years to extract the full market value of every drop of canal water supplied has apparently gone to dangerous lengths, and should be reconsidered. It cannot be right that in years of famine canal villages should be nearly as badly off as unirrigated villages, but this was the case, I consider, in a number of cases in the Hissar and Rohtak districts in 1899 and 1900. I drew the attention of Deputy Commissioners specially to this subject, and a copy of my letter is appended to this note, and I need not, I think, say more upon it here than that the question is essentially one of departmental considerations which require to be carefully reweighed by the light of past famine experience and the new famine policy.

Circular No. 165, dated Delhi, 17th April 1901.

From—The Hon'ble Mr. H. C. Fanshawe,
Commissioner and Superintendent,
Delhi Division,

To—The Deputy Commissioners, Hissar, Rohtak,
Gurgaon, Delhi, and Karnal.

I have the honour to invite your attention to paragraph 14 of the Review by the Hon'ble the Lieutenant-Governor of the Revenue Report of the last year, and to request that when you have leisure you will favour me at length with an expression of your views upon crop failures caused by the withdrawal or insufficient supply of canal water.

2. To form a basis for a proper judgment on this subject it will be necessary to collect data of the average area of canal crops which failed some 7-8 years before the system of reduced canal supply was introduced, and of the area which has failed in normal years since, a separate detail being given of the area which failed in the present and the late famine year. It will require some careful consideration to secure reliable average figures to be compared with those of the Irrigation Department for which you will probably have to apply to the Executive Engineer, and it will be well for the Revenue Extra Assistant Commissioner to draw up for your approval a memorandum of the way in which these figures are to be prepared.

3. Our experience this year and last has shown clearly, I think, that a more elastic system of remissions is needed in this Division, and in your report you should note in detail a number of special cases of failure which tend to show this over and above the general area figures which I have called for.

Mr. G. M. R. Field.

Note, dated 1st October 1902, by G. M. R. Field, Esq., Officiating Chief Engineer, on certain questions raised by the Hon'ble Mr. J. Wilson, Settlement Commissioner, Punjab, and by Colonel Jacob, R.E., late Chief Engineer, Public Works Department, regarding the proper methods of utilizing the waters of the Punjab rivers for irrigation.

1. Certain questions were raised by the Hon'ble Mr. Wilson in his evidence before the Irrigation Commission. These may be quoted below:—

> I.—To reserve the water of the Beas and Sutlej rivers, which it is proposed to carry on to the Montgomery Bar by means of the Lower Bari Doab Canal, entirely for the irrigation of land on the left bank of the Sutlej in Bikaner, Bahawalpur, and Rajputana and in the Ferozepore district.
>
> II.—To carry out the irrigation of the Montgomery Bar by means of a canal which would utilize the surplus waters of the Jhelum and Chenab rivers. This canal would presumably take out of the Jhelum and carry the surplus water of that river into the Chenab somewhere above the Khanki weir. A new canal would then take out from the left bank of the Chenab above Khanki and run across the Ravi on to the high lands of the Montgomery Bar.
>
> III.—To construct a weir across the river Chenab below its junction with the Jhelum and carry the water thus raised down to and across the Ravi to take up the irrigation of the present Sidhnai Canal and extend it still further into the Mooltan district.
>
> IV.—Mr. Wilson also went on to say at page 301 with regard to proposal I: "Moreover, there are further untold millions of acres in the Rajputana Desert which it is quite feasible to irrigate from the Punjab rivers."

These proposals were put forward by Mr. Wilson in two notes which are printed at pages 297—302 of the Punjab Evidence before the Irrigation Commission.

2. In addition to the above a communication has been received from Colonel S. L. Jacob, R.E., C.I.E., who was for the greater part of his service a Superintending Engineer in the Irrigation Branch and who was lately Chief Engineer of the Public Works Department, Punjab. The views expressed by Mr. Wilson and those expressed by Colonel Jacob, R.E., are practically the same. Colonel Jacob, R.E., as a Canal Engineer indicates more precisely the methods he would employ. The main principle, however, is the same, and that is, that the waters of the Sutlej should be entirely reserved for the irrigation of the country on the left bank of that river; that the irrigation of the highland between the Sutlej and Ravi which it was proposed to irrigate from the Sutlej should be irrigated from the spare waters of the Jhelum and Chenab rivers.

3. It is proposed to examine into the feasibility of this proposal. The scheme must be considered from three points of view:—

(1) Is it practicable from an engineering point of view, *i.e.*, do the levels admit of it, and is the water-supply sufficient?

(2) What will be the approximate cost of the scheme?

(3) What sort of country can be irrigated on the left of the Sutlej, and is it worth doing?

4. A plan has been prepared which gives roughly the contours of the Punjab and which thus shows the general direction of the slopes. It will be better to consider, firstly, the proposal to irrigate the Montgomery Bar by means of surplus water from the Jhelum and Chenab rivers. In doing so it will be necessary to assume that this irrigation is to be perennial. No scheme of colonization would succeed that depended on *kharif* irrigation alone. It is therefore necessary to see how much water is required at the tail end of the series; that is to say, for the Montgomery Bar. This will be discussed in paragraph 7.

5. The first scheme is to carry the surplus water of the Chenab river to Wan Radharam to irrigate the Lower Bari Doab. A plan and a longitudinal section that are attached to this note show that a canal from the Chenab river above Khanki to the Ravi opposite Sharakpur and thence to the alignment of the Lower Bari Doab Canal at Wan Radharam is quite feasible. The bed of the Ravi is at a higher level than the bed of the Sutlej on the opposite side of the Doab; this is evident from the levels of the Ravi at Lahore and of the Sutlej at Sabraon given on the general map, scale 16 miles to an inch, which accompanies this note; so that a canal from the Ravi has a very much better command at Wan Radharam than a canal from the Sutlej river. The line from the Chenab to the Ravi whose longitudinal section is given does not follow the main line and Gugera Branch of the Chenab Canal as suggested by Colonel Jacob, but goes direct *viâ* Shekhupura and Sharakpur. The idea of this line is that a good deal of irrigation might be done higher up the Deg Valley than is possible by any branch from the Chenab Canal, but there is little doubt that the line proposed by Colonel Jacob would be the cheaper, and the levels on this plan and section show that the command is ample.

In note No. XLI, page 149 of the notes for the Irrigation Commission, it is noticed that a canal taking out from

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the Chenab river on the borders of the Jammu and Sialkot district is quite feasible; in fact, the earlier proposals for the Chenab Canal contemplated placing the head at Pall in the Sialkot district. If this canal could be shown to be needed and were made, it would offer the simpler solution of conveying the waters of the Chenab to the Ravi, otherwise the less expensive method would be to carry the water down the present main line and Gugera Branch to about Feroz and then across the Ravi Valley. In that part of the Sialkot and Gujranwala districts to be irrigated by such a canal, the depth of wells varies from 10 to 30 or 35 feet, so that *kharif* irrigation only would be required; the surplus waters of the Chenab river during the *rabi* season being passed on to the Lower Bari Doab.

6. *The line from the Jhelum to the Chenab river.*—An examination of the levels of the weirs at Rasul and Khanki on the general map shows that the Khanki weir crest is higher than the Rasul weir crest, and so the water could not be brought up from Rasul to Khanki. To take out any canal higher up the Jhelum in order to enter the Chenab above Khanki is impracticable owing to the Pabbi range of hills which are on the left bank of the Jhelum and rise to a height of 1,400 feet. But the plan and longitudinal section show a line of levels from Rasul along the road from Mung to Phalia and thence to Ramnagar. The section shows that a canal on this line would deliver water at Phalia and further surveys would be required to show the best point to enter the Chenab river, but probably it would be best to reach the Chenab about the town of Kadirabad.

The R. L. of bed of Jhelum Canal at Rasul is 701·0, and the section shows that we can easily enter the Chenab river at Kadirabad. This point is some 30 miles below Khanki, and the slope of the river Chenab as given at paragraph 26, page 105, of Chenab Canal Project Report, is about 1·66 feet per mile. The level of the Chenab Canal regulator at Khanki is 714·23; hence we may assume that the regulator at Kadirabad would be (30 × 1·66 =) 49·8 lower, *viz.*, 664·43. A canal from this point with a bed slope of nine inches to the mile would strike the Jhang Branch about the 35th mile with a bed level of 627, which is approximately the present level. It would therefore be possible to relieve the Chenab Canal system of the whole irrigation on the Jhang Branch below this point. The supply required for the Jhang Branch at this point is about 2,000 cusecs. It would therefore be feasible to save the whole of this for the irrigation of the Montgomery Bar if the same amount of water could be replaced from the Jhelum.

The supply required for the Jhelum Canal when the irrigation is fully developed is about 3,800 cusecs. The minimum cold-weather supply in the river Jhelum was recorded on the 1st March 1902 and amounted to 4,770 cusecs. We can therefore ordinarily only depend on about 1,000 cusecs to spare from the Jhelum. It will therefore not be feasible to cut off so much of the Chenab Canal area as the above proposal for the canal from Kadirabad would contemplate.

It will probably suffice to carry the supply along the Main Line Jhelum Canal, the Southern Branch, and the escape and tail it into the Chenab river at Hazara above Midh, from which point the command of the Jhang Branch lower at Amipur, and the Gugera Branch lower at Tarkhani, could be got. This is the line proposed by Colonel Jacob in paragraph 19 of his note, and will be the one chosen for the purpose of estimating the cost in paragraph 14. But it is a matter for more detailed investigation to decide which will be the better line for the junction canal.

7. The project for the Lower Bari Doab Canal estimated that a supply of about 3,000 cusecs would be required for that canal. We may therefore assume that we have to deliver about 3,000 cusecs on to the Montgomery Bar at or near Wan Radharam, where the irrigation from the Lower Bari Doab Canal was supposed to begin.

Colonel Jacob says we need not begin so high up as Wan Radharam, as extensions of the Bari Doab Canal will cover this. He proposes beginning irrigation about Montgomery, which is 28 miles lower down the Doab. This, however, is a detail which need not detain us, especially as it is a disputed point whether any great extensions of the Bari Doab Canal are possible.

The river Ravi cannot be depended on for any cold-weather supply, as the whole of it is used up in the Bari Doab Canal. The 3,000 cusecs required must therefore come from the Chenab and Jhelum rivers. The Chenab Canal irrigates, roughly, two million acres and the supplies carried vary from a minimum of about 4,000 cusecs to 10,000 cusecs. When the river is low, it is all the canal can do to mature the winter crops. The only way therefore that any supply can be spared for the Montgomery Bar will be to cut off some of the Chenab irrigation from the Chenab Canal and supply it from elsewhere. The longitudinal section referred to in paragraph 5 as attached to this note shows that a canal can be made from the Khanki weir to cross the Ravi Valley and emerge on the Montgomery Bar near Wan Radharam. The command is ample. It is therefore evident that the levels will admit of a supply of water being brought from the Jhelum into the Chenab and from the Chenab into the Ravi and then on to the Montgomery Bar. But the question turns on the amount of water available in the Jhelum. This has been shown to be only 1,000 cusecs and the Montgomery Bar will require about 3,000 cusecs for its irrigation. It will therefore not be feasible to carry out this project unless the Jhelum supply can be augmented in some way. The only way in which the Jhelum supply might be increased would be by bringing the water of the Indus across from Kalabagh into the Jhelum, and the feasibility of doing this may now be discussed.

8. The contoured plan of the Sind Sagar Doab, of which a blue print is attached to this note, shows that the minimum low water-level of the Indus at Kalabagh is 680·10. The gauge is in the town above the shingle bar and nearly opposite the site where a canal if made would take out of the Indus. The distance to Khushab *viâ* Mianwali is about 85 miles. The low water-level of the Jhelum river at Khushab is 581·60, or nearly 100 feet lower than the Indus water at Kalabagh; so that it is evident the levels would admit carrying this water over the Jhelum river waters, but the extra land to be got by doing this would not pay for the cost of such a colossal work. By building a weir at Khushab an R. L. of full supply of 585·00 could easily be got for a canal on the left bank of the Jhelum. But this level would only command the lower Khadir lands of the Jhelum Valley at present irrigated by the new Sahiwal Canal and the tail distributary of the Northern Branch. The Bar lands are quite out of reach of a canal from Khushab. The bed level of the head of the Sulki Branch is 617·4, or 32 feet above the Jhelum at Khushab at a point 20 miles away. The bed level of the Northern Feeder is 585·8, where it crosses the Sahiwal-Chiniot Road. This is a point 35 miles down-stream of Khushab and cannot be commanded from the canal from that point. The head of the Khadir Distributary which is fed from the tail of the Northern Feeder has a bed level of 554·5 in the Khadir, the drop from the highland being 21 feet. This point is about 40 miles from Khushab and is quite the highest point that the canal could command; hence the only portion of the Jhelum Canal area which would be irrigated from the Indus Canal would be a very small part of the Khadir, requiring at the most about 300 cusecs. The supplementary supply thus obtained from the Indus would be inappreciable, and we can only rely on the 1,000 cusecs to spare at Rasul as before noted.

9. It will be useful to notice here how small a part of the basin of the Indus and its tributaries can be irrigated from the waters of the Indus at Kalabagh even though there is such a good command of the Jhelum at Khushab. It has just been pointed out that the Indus water delivered at Khushab could not be got on to the highland of the Jech Doab, but could only irrigate the Khadir lands. If the water from Khushab were taken along a hydraulic contour, *i.e.*, along the highest alignment on which water would flow, it could not be delivered in the Rechna Doab much higher up than Jhang. Jhang is on the 500 feet contour and about 70 miles from Khushab. From Jhang the 500 feet contour goes to Chichawatni, and a canal from the Chenab at Jhang would do very little more than command the Sidhnai Canal, the head of which is about 130 miles from Khushab and the full supply level required about 464, so that the level of 585 at Khushab is only about sufficient, That part of the valley of the Indus and its tributaries lying to the left of the Chenab down-stream of the Sidhnai head is already irrigated from inundation canals and does not need water from Kalabagh. To the right of the Chenab lies the Sind Sagar Doab, which we know can be irrigated by a big canal from the Indus taking out at Mari opposite Kalabagh so soon as the time is ripe.

The total area of the Sind Sagar Doab is 8,180 square miles and the cold-weather supply of the Indus is about 20,000 cusecs. There is water to spare in the Indus at Kalabagh, for the low water discharge of the Chenab is about 4,000 cusecs while the commanded area is about 6,700 square miles. But it does not seem possible to use this

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great surplus of cold-weather water over that required for the irrigation of the Thal to advantage anywhere in the Punjab.

10. With reference to the third proposal made by the Hon'ble Mr. Wilson as abstracted in paragraph 1 of this note, it may be explained that the levels on the general map attached to this note show that it is possible to supply water to the Sidhnai Canal from the Chenab below the junction of the Jhelum if a weir is built at that place. The cold-weather water surface at the junction is about 480·0 and with a weir a full-supply level of 490 might be got. The distance to the Sidhnai head is 40 miles, and water could be delivered there at a level of 490—40 × 0·75 =460, or 5 5 feet above the canal bed. This is a poor command, but a reduction of the bed slope from 9″ to 8″ a mile would give ample command; so that the scheme is likely to be feasible.

On the right bank of the Chenab below the confluence of the Jhelum are 500 square miles of country between the Chenab river and the high bank of the Doab which could also be irrigated by a canal from above this weir. This tract is under survey.

It should again be noticed here that the 500 feet contour goes almost due south from Jhang to Chichawatni, and therefore a canal from the junction of the Jhelum and Chenab could never get much command of the Rechna Doab, though it might give fertilising water to the lands along the river in the Shorkot Tahsil, which are believed to be of poor quality, and would be much better off if irrigated with Jhelum river silt instead of obtaining water free from silt from the tail end of the long Chenab Canal.

If all the spare water of the Jhelum were taken across to the Chenab, there would be no supply to be caught by a weir below the junction of the Chenab for the Sidhnai in the *rabi;* but as the Sidhnai Canal only irrigates in the *kharif* season, there is no objection to this, and the supply would probably arrive earlier and stay later than the supply from the Ravi only. On the other hand, if surplus water were brought to Khushab from the Indus, there would always be ample water for the Sidhnai.

11. This part of the general question may therefore be summarized briefly by saying that it is quite feasible from an engineering point of view to carry water from the Jhelum and Chenab rivers for the irrigation of the Montgomery Bar. At the same time it is not at present evident that there will be much more than 1,000 cusecs available at Rasul on the Jhelum for this purpose. It is possible that in the near future by judicious economy of water on the Jhelum and Chenab Canals the amount required, *viz.*, 3,000 cusecs, might be made available, but, so far as we can see at present, this is not the case.

12. The question of cost may now be considered, it will only be possible to give very rough figures. The cost may be estimated under the following heads:—

(1) Channel from Kalabagh to Khushab to convey the Indus water to the Jech Doab.

(2) Weir at Khushab with feeder channels to take up the irrigation of the Jech Doab.

(3) Enlarging present Jhelum Canal to carry the surplus water from Rasul to the Chenab at Hazara above Midh.

(4) Weir across the Chenab at Hazara.

(5 New feeder channels to connect the new supply at Hazara to the existing channels of the Chenab Canal.

(6) Alterations of existing channels of the Chenab and new channel from Feroz to the Ravi to convey waters set free at Khanki to Wan Radharam.

(7) Weir across the Ravi.

(8) Channel from the Ravi to Wan Radharam.

(9) Weir at Hariki on the Sutlej river to feed a canal to Bahawalpur.

(10) Canal to irrigate Bahawalpur.

(11) Cost of the main line of present proposed Lower Bari Doab which will not be required if these proposals are carried into effect.

13. ***The channel from Kalabagh to Khushab.***—Although it is not likely that this part of the scheme will be found practicable or necessary, it will be as well to see what it is likely to cost.

In 1871 Mr. Andrews estimated in detail that a canal of 150 feet bed width, and 5,000 cusecs discharge would cost Rs. 54,29,000 for 30¼ canal miles, or 28·6 statute miles. This is the distance from Mari at the head to Mianwali. This cost is at the rate of Rs. 1,90,000 a statute mile and Rs. 38 a cusec a mile.

The distance from Mianwali to Khushab is about 57 miles. This portion of the line will be very much cheaper than the line from Mari to Mianwali. It will not be more costly than the Jhelum Canal main line, which cost about Rs. 75,000 a mile for a discharge of 3,800 cusecs, or Rs. 20 a cusec per mile. But if a channel were made to carry only 1,500 cusecs for the Jech Doab, it would cost a great deal more per mile or per cusec than the rates got for the Jhelum Canal main line; whereas, if a canal were made to irrigate the whole of the Sind Sagar Doab for which a discharge of about 12,000 or 15,000 cusecs would be required and such a canal was made large enough to carry the extra 1,500 cusecs needed at Khushab for the Jech Doab, the rates would be lower than those for the Jhelum Canal main line. The proportionate cost debitable to the water transferred to the Jech Doab would be much smaller if such a large canal were made than if a canal were made to give only 5,000 cusecs for the irrigation of the Sind Sagar Doab and 1,500 cusecs to the Jech Doab, and very much smaller than if a canal to deliver only the 1,500 cusecs needed were made, so that the cost of the water from the Indus delivered at Khushab will depend on the arrangements made for the irrigation of the Sind Sagar Doab which cannot be foretold at this early stage of that project. However, as a very rough approximation, the cost may be estimated at Andrews' rates for the portion to Mianwali and at main line, Jhelum Canal, rates for the portion from Mianwali to Khushab as follows:—

1,500 cusecs × 28·6 miles × Rs. 38 + 1,500 cusecs × 57 miles × Rs. 20 = Rs. 33,40,200, say, Rs. 34,00,000.

This estimate is for works only. The usual establishment and tools and plant percentages and indirect charges must be added. The weir at Khushab would cost more than the weir at Rasul, as the site is not so favourable. The weir at Khanki has cost up to date about Rs. 42,00,000 against 30 lakhs of rupees, the cost of the Jhelum weir. The weir at Khushab may be estimated at 40 lakhs of rupees for works only. The feeder channels from Khushab to take up the present irrigation in the Jhelum Khadir lands commanded by the weir at Khushab may be estimated at 10 lakhs of rupees.

The whole scheme would then cost for "works" only as follows:—

	Rs.
Line from Mari opposite Kalabagh to Khushab	34,00,000
Weir at Khushab	40,00,000
The feeder channel	10,00,000
TOTAL .	84,00,000

The usual percentage charges for establishment, etc., and indirect charges for capitalized abatement of land revenue, etc., would bring the cost up to Rs. 1.05,00,000, or about Rs. 10,500 a cusec delivered at Khushab.

14. It will be better to estimate the enlarging of the Jhelum Canal on the supposition that no reduction of the present area commanded can be made by bringing water from the Indus at Kalabagh. The present main line carries 3,800 cusecs, and 3,000 cusecs more should be carried if sufficient water is to be set free from the Chenab to irrigate the Lower Bari Doab area.

The main line, Jhelum Canal, which is 37 statute miles long, cost Rs. 27,93,000 for works only, and the enlargement of this channel to practically double its capacity may be estimated at the same price, *viz.*, Rs. 28,00,000. The Southern Branch and escape to the Chenab must both be enlarged to take extra supply. The total length of channel from the end of the main line to the river is 25 miles, and its cost may be estimated at the same rate, as the main line, Jhelum Canal, *viz.*, 25÷37 × Rs. 28,00,000 = Rs. 18,91,891, say, Rs. 19,00,000. A weir would be required on the Chenab at Hazara above Midh, where the Southern Branch escape tails into the river; this would cost about Rs. 50,00,000.

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A channel 50 miles long will be required from the weir on the Chenab to connect up with the existing Jhang Branch Upper at its tail, which may be estimated at the same rate as the channel from the end of the Jhelum Canal main line to the Chenab above Midh, or at about Rs. 38,00,000 as it is twice as long. A channel would be required to carry about 1,000 cusecs across to the Lower Gugera Branch at Tarkhani, a distance of 25 miles. It may be estimated at Rs. 30 a cusec a mile, and the cost will be 1,000 cusecs × Rs. 30 × 25 miles = Rs. 7,50,000. The cost then of bringing the Jhelum river water from Rasul to where it is needed on the Chenab will be as follows:—

	Rs.
Enlarging Jhelum Canal main line . . .	28,00,000
Channel from end of main line to river . .	19,00,000
Weir across Chenab .	50,00,000
Channel from weir to Amipur . . .	38,00,000
Channel from Amipur to Tarkhani	7,50,000
Total I—Works only .	1,42,50,000

To this may be added 25 per cent. to cover establishment, tools and plant and indirect charges, making the total for all charges Rs. 1,78,00,000, or Rs. 5,933 per cusec of the 3,000 cusecs to be carried by the channels.

15. The cost of transferring 3,000 cusecs from the Chenab river at Khanki to the Lower Bari Doab Canal at Wan Radharam may now be estimated.

The supply of 3,000 cusecs brought from the Jhelum river to Amipur to do the irrigation of the lower part of the Rechna Doab will enable the main line of the Chenab Canal to carry the supply intended for the Lower Bari Doab Canal without any enlarging. The Gugera Branch too will be relieved of about 1,000 cusecs discharged at the head and will need enlarging as far as Chuharkhana or Feroz to carry an extra 2,000 cusecs only instead of 3,000 cusecs. From the Gugera Branch at Feroz or Chuharkhana a channel to carry 3,000 cusecs must be built across the valley of the Ravi and through the highland of the Bari Doab to Wan Radharam. A weir will also be required across the Ravi. In addition to these works some remodelling of the present channel of the Chenab Canal below the off-take of the Gugera Branch to the point where the supply from the Jhelum meets them will be required in order to reduce them to a size suitable for the reduced discharge they will then have to carry. Much the same rates may be used to estimate these works as were employed for the channel from the Jhelum at Rasul to Amipur. Carrying 2,000 cusecs along 30 miles of the Upper Gugera Branch may be estimated at Rs. 30 a cusec a mile—

	Rs.
2,000 × 30 × 30 = . .	18,00,000

Carrying 3,000 cusecs from the Upper Gugera Branch to Wan Radharam, a distance of 71 miles, on the alignment shown in the tracing referred to in paragraph 6, this will be an expensive channel, as the section shows that for 20 miles across the Deg Valley the bed is out of soil and may be estimated at Rs. 100 a cusec a mile—

	Rs.
3,000 cusecs × Rs. 100 × 71 miles = . . .	2,13,00,000

The weir across the Ravi may be estimated at Rs. 10,00,000. It is true that the Sidhnai weir originally cost only Rs. 1,42,949, and up to date has cost about Rs. 2,60,000. But it is much further down a river in which the discharge is apt to dwindle down in the lower reaches, and it was made of a very economical design, and should a weir be built for this large project, it will be made in a much more substantial manner and the connected works are likely to be more costly.

The remodellings to the Chenab Canal may be estimated at Rs. 10,00,000. The total cost of carrying the waters from the Chenab at Khanki to Wan Radharam may then be estimated as follows:—

	Rs.
Enlarging Upper Gugera Branch	18,00,000
Channel from Gugera Branch to Wan Radharam	2,13,00,000
Weir across the Ravi . .	10,00,000
Remodellings of the Chenab Canal	10,00,000
Total for I—Works only .	2,51,00,000
Add for establishment, tools and plant and indirect charges 25 per cent. . .	62,75,000
GRAND TOTAL .	3,13,75,000

This is at the rate of Rs. 10,455 per cusec on the 3,000 cusecs carried.

16. The cost of the works at Hariki and a canal to irrigate Bahawalpur territory may now be considered. In the Lower Bari Doab project the weir on the Sutlej is estimated at Rs. 85,64,056. The canal to irrigate the Bahawalpur State will be about the same size as the Chenab Canal and may therefore be estimated at Rs. 2,60,00,000 less the cost of a weir which will cost about Rs. 86,00,000 rather than Rs. 30,00,000 which was the cost of the Khanki weir, or, say, Rs. 2,30,00,000.

But it is probable that the weir will also be used to feed *kharif* canals on the right and left bank, and that these canals will bear some share of the cost of the weir and of the main line of the canal to Bahawalpur. How much should be written off for this is not easy to say, but about 50 lakhs of rupees will probably represent the share of the cost chargeable to this *kharif* irrigation.

The canal from Hariki will then cost as follows:—

	Rs.
Weir for I—Works only ..	86,00,000
Add 25 per cent. for other charges	21,50,000
Total .	1,07,50,000
Canal	2,30,00,000
Total .	3,37,50,000
Deduct	50,00,000
GRAND TOTAL, ALL CHARGES .	2,87,50,000

17. The general abstract of the cost of the scheme for transferring water from the Jhelum river across to the other rivers in order to set free the Beas water for irrigation on the left bank of the Sutlej is then as follows, omitting the cost of bringing Indus water to Khushab:—

	Rs.
Cost of taking Jhelum water to the Chenab . . .	1,78,00,000
Taking Chenab water to Wan Radharam . . .	3,13,75,000
Total cost of irrigating Lower Bari Doab from Chenab and Jhelum waters . . .	4,91,75,000
Cost of taking Beas water to the land to be irrigated in Bahawalpur . . .	2,87,50,000
	7,79,25,000

From this sum might be deducted the cost of the main line of the Lower Bari Doab Canal from the weir on the Sutlej to Wan Radharam as this work will be saved.

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This main line is estimated to cost—

	Rs.
For works only	1,18,86,541
Add 25 per cent. for other charges	29,71,635
Total .	1,48,58,176
Say .	1,49,00,000

The net charge that should be made against the irrigation to be got from the canal to Bahawalpur State will then be Rs. 6,17,88,000.

The area irrigated might eventually be about the same as that on the Chenab, or 2,000,000 acres, and in that case the cost will be Rs. 32 an acre; but seeing that the soil is poor, the tract is uninhabited, and the colonization to be done by British subjects in native territory, the area should not be estimated at more than 1,000,000 acres, and the cost will then be Rs. 64 an acre irrigated annually.

The cost per acre irrigated annually of the existing canals is as follows:—

	Average of 10 years.	Average of last 3 years.
Swat River Canal . .	34·1	26·8
Western Jumna Canal .	33·8	28·4
Bari Doab . . .	27·0	23·1
Proposed Lower Bari Doab .	40·3	...
Sirhind Canal . . .	41·9	33·3
Chenab Canal . . .	39·4	18·8
Jhelum Canal (estimated) .	22·0	...

The cost of the Lower Bari Doab Canal was estimated at Rs. 3,32,73,225 and the cost of the works proposed to irrigate the same area from the Jhelum and Chenab now amounts to Rs. 4,79,38,000 *plus* the cost of the Montgomery Branch and its distributaries (Rs. 76,23,000), or Rs. 5,55,61,000 in all. The estimated profit from the Lower Bari Doab Canal scheme was 14·3 per cent. in the 19th year and it will still amount to 8·5 per cent. Hence the scheme might still be said to be profitable if the water were available.

18. We may now briefly glance at the country for the irrigation of which it is proposed to reserve the waters of the Beas and Sutlej. The Revenue Survey Department mapped the Bahawalpur country on the 4-inch to the mile scale about 1875 and the maps show that the highland is, like the Sind Sagar Thal, covered by sand-hills. The following description extracted from page viii of Synoptical Volume VII-A of the Great Trigonometrical Survey of India gives a useful description of the country, which shows that the soil is not unlike the more level parts of the Sind Sagar Thal, but that water is more difficult to obtain:—

"In the whole distance* between the Lune river and the Sutlej Series—250 miles—only one place, Phuloda, was met with which could be dignified by the name of a town. . . . There is not much difference in the barrenness in the country traversed by the whole series,* but if any, the northern portion in Bahawalpur is the most sterile. There the series passed over a length of 70 miles in which there were only three wells of drinkable water . . . In Bahawalpur the sand-hills grow smaller and fewer, and are replaced by long stretches of perfectly level hard clay like the beds of dried up tanks, separated by tracts of drifting sand, accumulating here and there into mounds; there is not a particle of vegetation save a few scattered *phog* (*Calligonum*) bushes. However, for two or three months in the year the desert presents a cheerful appearance. Each village has several hamlets, called *dhanis*, established where there is any hard soil capable of retaining water; in excavations made in this water lodges for two or three months after the rains, and the inhabitants of the villages come to these to feed their flocks and herds on the freshly-grown herbage, and to cultivate a few miserable fields which they have in the hollows between the sand-hills. The rainfall is, however, very small, four or five inches, and the inhabitants have a hard struggle for life in respect to both food and water. Their food they supplement with the seeds of various grasses, the principal of which is the *bhurut*†. . . . Water is collected in receptacles called *tankas*, cylindrical reservoirs about 6 feet in diameter and 8 or 10 feet deep, coated with chunam. When full they are covered in with brushwood and mud and are not used till the well water fails or becomes brackish, as generally happens in the hot weather."

The Eastern Sind Meridional Series passed through the lower end of the Bahawalpur State from Khangarh to Nowshera below the confluence of the Chenab, and the following description is given on page xvii of the same volume:—

"As the boundary between the Bahawalpur Desert and the valley of the Indus was approached, hills and long ridges of drift sand were met with, interspersed with stretches of low-lying, alluvial flats, which are mostly dependent on rainfall for their supply of water and are thus practically desert for the greater portion of the year. When rain does fall grass and shrubs spring up and render these tracts good grazing-ground for cattle and camels for a short time afterwards. To some of them flood waters of the Indus find occasional access by the old river channels, the deeper parts of which contain water for several months after the subsidence of the annual inundation, and are thus natural reservoirs; they are locally called *dhands*. Finally, the valley of the Indus was entered and the principal operations brought to a close on the two stations—Daowala and Machka."

19. These descriptions show that Bahawalpur territory is about the same class of country as the more level parts of the Sind Sagar Thal. It is obvious that the country being practically uninhabited a scheme for colonization must accompany any project for irrigation. It is, moreover, pretty certain that a gigantic scheme of colonization can only be successfully worked by the Supreme Government. Indirectly this would prove advantageous both to the Bahawalpur State and to the Imperial Government: to the former by rendering habitable a large area of unproductive land, and to the latter by affording an outlet for its own congested population. But the British Government has already in the Sind Sagar Thal an enormous area of 8,000 square miles, which by means of irrigation from the Indus (which is perfectly feasible) will afford outlets for congested populations for many years to come. The necessity therefore for a scheme to colonize and irrigate the territories of a Native State is not at present apparent.

It may also be remarked with reference to Mr. Wilson's statement quoted in paragraph 1 (iv), *viz.*, that millions of acres in Rajputana await irrigation from the Punjab rivers, that this is founded on a misapprehension of the nature of the country. The general plan attached shows that the portions of Rajputana which adjoin Bahawalpur and Bikaner are on the reverse slope; that is to say, the land slopes rapidly down from the Aravalli range of hills into the valley of the Sutlej. Hence it may be said that practically there is not a single acre of Rajputana which can be effectively commanded by the Punjab rivers. The levels seem to indicate that south of the Bahawalpur border there is no land commanded by the Punjab rivers except in the Khadir lands immediately contiguous to the rivers until the borders of Sind are reached, which it is believed are already irrigated to a great extent by the waters of the Indus.

20. The main object of these schemes is essentially to set free the waters of the Beas for the irrigation of the lands of the left bank of the Sutlej. We may, therefore, consider some other schemes which may further that end. The levels show that a canal taking out of the Sutlej at Phillour would get command of the Abohar Branch of the Sirhind Canal at about the 42nd mile (Akhara). From this point a feeder channel could get command of the Bhatinda Branch below the 60th mile (Dhepali). The water thus set free might possibly be sent across from Patiala to the Sirsa Branch at Kaithal and thence to the Hansi Branch at Jind. This water could be taken down the Rohtak Branch of the Western Jumna Canal into Hissar and Rohtak, and down the Kotla Branch of the Sirhind Canal to Sirsa, and in this way it is probable that all the unirrigated tract of British territory lying on the plain that slopes from the Himalayas towards the Bikaner border would be irrigated. But that part of British territory that lies on the plain that slopes from the Gurgaon and Rajputana hills could not of course be irrigated. Unfortunately there is not much

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* The Jodhpur Meridional Series referred to ran from Jodhpur through Phuloda, near Bikaner, Ghorgarh Maujgarh to Bahawalpur.

† Also eaten in the Thal called there *bhakra*. It is a thorny weed, *tribulus alatus*.

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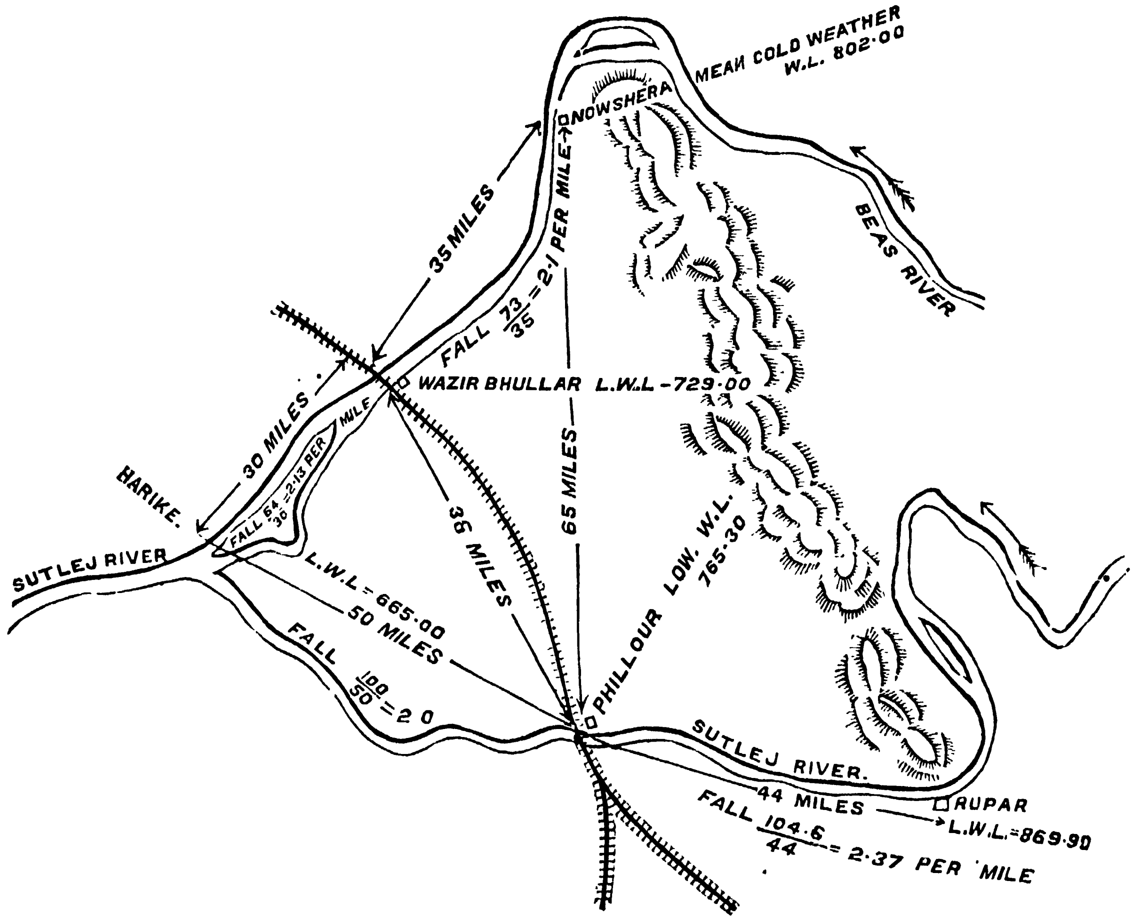
prospect of turning the Beas waters into the Sutlej at Phillour.

22. The following sketch shows that the Beas waters fall at much the same rate per mile as the Sutlej waters, and therefore water could not be taken from Wazir Bhullar on the Beas to Phillour on the Sutlej; the latter is 50 miles above the junction, whereas the former is only 30 miles above the junction:—


MEAN COLD WEATHER W.L. 802·00
NOWSHERA
BEAS RIVER
35 MILES
FALL 73/35 = 2·1 PER MILE
WAZIR BHULLAR L.W.L -729·00
65 MILES
30 MILES
HARIKE.
FALL 64/30 = 2·13 PER MILE
SUTLEJ RIVER
L.W.L = 665·00
50 MILES
FALL 100/50 = 2 0
36 MILES
PHILLOUR LOW. W.L. 765·30
SUTLEJ RIVER.
44 MILES
RUPAR
L.W.L.=869·90
FALL 104·6/44 = 2·37 PER MILE

Since the level at Phillour is 765·30 and the distance to Nowshera is 65 miles, the fall consumed would be about 50 feet; so that, if the waters could be raised at or above Nowshera to 816·00 about and taken in a straight line to Phillour, they could be carried across the Sutlej by a weir and delivered into the Sirhind Canal at Akhara. But there are no levels of the Jullundur Doab or surveys of the Beas to show whether this would be feasible. It is probable that in any case the work would be extremely costly, as several rivers or large drainages are known to cross this country, besides the whole drainage of the foot hills of the Himalayas which flows towards the Beas.

22*a*. The cold-weather discharge of the Beas seldom falls much below 4,000 cusecs, and a canal for that discharge could be built. The discharge of the Abohar Branch, Sirhind Canal, below the 42nd mile, is about 1,500 cusecs, and that of the Bhatinda Branch below the 60th mile, 1,000 cusecs.

There are 500,000 acres at the tail of the Kotla Branch in British territory that could be irrigated. At the low allowance of 2 cusecs per 1,000 acres, 1,000 cusecs would be required for these. So that 3,500 cusecs could be thus utilized and the balance could be utilized in giving more water to tracts which at present have a poor supply. The supply that could be sent across from the Sirhind to the Western Jumna districts would be the 2,500 cusecs saved on the Abohar and Kotla Branches. The discharge of the Sirsa Branch below Kaithal is about 800 cusecs and that of the Hansi Branch below Jind about 800 cusecs. So that 1,600 cusecs would be thus set free to go down the Bhowana Branch to Rohtak, leaving 900 cusecs for extensions on the Hansi and Sirsa Branches.

23. The cost of such a scheme would be very great. The main line of the Sirhind Canal cost nearly Rs. 98,00,000 for works only for 37 statute miles, and the channel from the Beas to the Sutlej would on the same lines cost $\frac{65}{37}$ × Rs. 98,00,000, or about Rs. 1,73,00,000. It is probable it would cost much more. The weir at Phillour might cost nearly as much as that at Sobraon, *viz.*, Rs. 87,00,000. The weir on the Beas would also be very expensive, because a large amount of heading up must be attained, say, Rs. 80,00,000. The cost of the canal from the Sutlej to link up the Abohar and Bhatinda Branches and the canal across to the Western Jumna and the extensions might cost Rs. 2,00,00,000.

The total cost for works would then be—

	Rs.
Weir on Beas . . .	80,00,000
Weir on Sutlej . . .	87,00,000
Main line, Beas to Sutlej .	1,73,00,000
Canals to Sirhind and Western Jumna Canal . . .	2,00,00,000
Total .	5,40,00,000
Add 25 per cent. .	1,35,00,000
GRAND TOTAL .	6,75,00,000

The construction of such works, however, is practically barred by the fact that the minimum supply in the Beas and Sutlej is 4,000 cusecs. If this supply is reserved for the left bank irrigation for Bikaner and Bahawalpur, it is obvious that no surplus is available for any help to the Sirhind Canal system If the scheme for the irrigation of the Bahawalpur State from the Beas and Sutlej were set aside, then it might be possible to utilize all the available

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supply of the Beas for irrigating British territory in Hissar, Sirsa and Rohtak. The two schemes, however, cannot go together.

24. The great schemes of diverting the waters of the Punjab rivers to the east and helping one river from another may therefore be said to be quite feasible from an engineering point of view. That is to say, the levels admit of such a procedure, and there are no insuperable difficulties in the way. But the cost of such schemes will necessarily be extremely high. This in itself is of course no bar to their construction, for it is evident that in course of time, as the pressure of population increases, it will be absolutely necessary to extract more from the soil, and the value of water and necessity for irrigation will be so great that very costly schemes will be cheerfully undertaken. There is, however, the one great obstacle of the water-supply. It has been shown in the foregoing paragraphs that—

(1) The Indus carries a practically unlimited supply, but that the levels do not admit of its helping out the supply in the other Punjab rivers to any appreciable extent.

(2) That though feasible to carry Jhelum and Chenab waters into the Ravi and thus set free the Sutlej waters for its left bank, the available supply in the Jhelum does not exceed 1,000 cusecs; and therefore that unless economies of water hitherto unsuspected can be effected, it will not be possible to irrigate the Montgomery Bar with a perennial canal by any such scheme.

(3) That even if the whole of the Sutlej and Beas waters could be diverted to the left bank, the greater part of the territory irrigated would be a sandy desert; at present almost uninhabited, and which moreover belongs to a Native State. A gigantic scheme of colonization would be required to render effective any project of irrigation.

(4) That it might be possible at very heavy expense to divert the supply of the Beas and Sutlej to assist the irrigation of the Sirhind Canal system and thereby render available a portion of the Sirhind supply for the irrigation of Hissar, Rohtak and Sirsa. But any such scheme must be only as an alternative to the irrigation of the Bahawalpur State, as there is not enough water available in the Beas and Sutlej for both schemes at once. If, however, it proved feasible to carry Beas water across the Jullundur Doab to help the Sirhind system, it might be worth considering whether this scheme, should not take precedence of the Lower Bari Doab Canal scheme, as thereby the most famine-stricken portion of the Punjab could be thoroughly protected and the colonization of the Montgomery Bar could very well wait for further developments of irrigation science on the Jhelum and Chenab schemes whereby water might be made available.

25. It will be observed that the whole of the preceding remarks have been based on a supposition that any irrigation projects undertaken will be of the nature of perennial canals. The reasons of this have been alluded to, the principal being that it is not believed that colonization schemes can be successfully carried out except on a perennial supply basis. If, however, this objection were overcome, it is possible that enormous areas could be irrigated in Bahawalpur, etc., by *kharif* canals. These schemes, however, have not been touched upon, because it is obvious that all the Punjab rivers carry practically unlimited *kharif* or flood supplies, and hence no very special measures of helping one river from another would be required. If the principle of *kharif* irrigation only be accepted, there is no reason why it should not be carried out at once on all Punjab rivers. The *kharif* canals, however, must be more or less separate from the perennial, as the practical difficulties of carrying an enormous *kharif* supply and a very small *rabi* supply in the same channel are almost insuperable.

Note dated 25th October 1902, by G. M. R. Field, Esq., Officiating Chief Engineer, Punjab Irrigation, on proposals for the improvement and extension of irrigation in the Punjab.

1. In a recent note, dated 1st October 1902, I investigated certain proposals put forward by the Hon'ble Mr. J. Wilson and Colonel S. L. Jacob, R.E., regarding the transfer of the waters of the Punjab rivers to the east. The note in question was written somewhat hurriedly, as the matter had to be laid before the Irrigation Commission, and Sir Thomas Higham, K.C.I.E., was extremely anxious to discuss the proposals with me before the Irrigation Commission started on its first tour early in October. I dealt therefore almost entirely with the main question of bringing the waters of the Jhelum and Chenab rivers on to the Montgomery Bar in lieu of irrigating that tract from the Sutlej.

2. The note in question showed that, if we took the minimum recorded discharge of the Jhelum, we could only be certain of 1,000 cusecs in the cold weather. It was also shown that it was only possible to set free from the Chenab system a tract requiring a cold-weather discharge of about 2,000 cusecs. The Montgomery Bar requires for its irrigation about 3,000 cusecs in the *kharif* season, although it is probable that it would be possible to manage with about 2,000 cusecs for a short period in the cold weather. The project therefore did not seem quite feasible on account of the scarcity of water. But, on reconsidering the matter, I am of opinion that the view taken, although a safe one, was possibly somewhat extreme. As regards the Jhelum, our records show that the river very rarely falls to the minimum used in our calculations, *viz.*, 4,770 cusecs. That minimum has only once been reached, and it is probable that the supply will very rarely fall below 6,000 cusecs. The supply available for transfer elsewhere will therefore be generally nearer 3,000 cusecs than 1,000. It will therefore be possible to confidently detach the area requiring 2,000 cusecs from the Chenab system. This will render available that amount for the irrigation of the Montgomery Bar, and this low supply will probably not last more than two months of the cold weather. After that there will be plenty of water. The scheme therefore appears to me to be much more hopeful than at first sight. There is also one great advantage in this scheme, *viz.*, that the Montgomery Bar is almost the only place where water could be utilized; and if this space is irrigated from the Sutlej, we shall leave no place to divert the rivers Jhelum and Chenab in case it should hereafter be found that water was available. I would therefore now strongly advocate a thorough inquiry into these proposals and the holding in abeyance any project for putting a weir in the Sutlej.

3. We may now consider some other projects for extending irrigation. One of the most promising seems to me to be that for building a weir at Trimmoo at the junction of the Jhelum and Chenab. A rough approximation of the levels shows that by holding up the water at this point it is possible to run a canal past Shorkot into the Ravi at the head of the Sidhnai Canal. The Sidhnai Canal is a *kharif* canal, *i.e.*, it only runs during the flood season, and it is only in favourable years that it is able to supply one good watering for the *rabi* crop. It is well known that the supply in the Ravi is precarious. During the current year 1902 the flow has been most precarious. The irrigated area has fallen to about half the average, and even that will be matured with difficulty. Moreover, it is doubtful whether much *rabi* area has been irrigated. Under the circumstances the assistance given by a canal cut from the Jhelum and Chenab will be invaluable. It is known that these two rivers have a very small surplus in the cold weather. But this does not necessarily affect the project, as the Sidhnai system is a *kharif* system. Moreover, it is believed that enormous extensions of the Sidhnai will be rendered possible. There seems no reason why the Sidhnai Canal, if water can be rendered available, should not be extended right through the Mooltan district as far as the junction of the Chenab and Sutlej. It would then entirely supersede the present inundation system of the Mooltan Canals and might possibly even be extended into a part of the Lower Sutlej Canals system. This would all be rendered feasible by a weir at the junction of the Jhelum and Chenab rivers. But, in addition to this, there is a large tract of land on the right bank of the Chenab which is now being surveyed. It is believed that the whole of this could be easily irrigated, especially if a weir were built at the junction. A portion of this area was formerly irrigated by an inundation canal known as the Uch. The total area is not less than 500 square miles, or 320,000 acres, and the soil is believed to be good and fertile. The proposal for a weir at the junction of the Jhelum and Chenab rivers would therefore command an area on the right bank of some 500 square miles and on the left bank of about 2,000 square miles, including the present Sidhnai system and the area irrigated by the Mooltan Inundation Canals. No account has been taken of any portions of the Chenab system which might possibly be included if the levels served. The total

area commanded would be therefore about 1½ million acres which would bring it up to the Jhelum Canal system as regards size. Of course it is to be understood that a *kharif* canal only is contemplated, but this would involve no change in the present conditions. *Primâ facie* the project would appear to be quite feasible and very promising.

The above is written on the supposition that the present conditions will be maintained, *i.e.*, that the irrigation will remain on a *kharif* basis. A further proposal may, however, be put forward to convert the whole system into a perennial canal system. Levels show that it is possible to make a cut from the Indus whereby a perennial supply could be poured from the Indus into the Jhelum. This supply can be made to enter the Jhelum anywhere below Khushab. The supply in the Indus is practically unlimited and water can be abstracted from that river without prejudice to any scheme for the irrigation of the Sind-Sagar Doab. A canal cut, such as is now contemplated, could be brought from Kalabagh on the Indus to any suitable point above the junction of the Jhelum and Chenab rivers. It would be the first step towards the Sind-Sagar Canal, and no great engineering difficulties are to be apprehended. The great Sind-Sagar Canal of the future would be a branch taking off from this cut. This canal would render the irrigation of the Sidhnai and the Mooltan Canals systems perennial Moreover, this proposal does not affect the proposal already put forward to build the weir at the junction of the Jhelum and Chenab rivers, as it would merely result in converting a *kharif* system into a perennial system, and the former system (*kharif*) would always be carried out first, as it would create no alteration in present conditions.

4. The condition of Hissar and Sirsa, and portions of Rohtak and Karnal, has long been a cause of great anxiety. The continual failure of the rains and the short supply in the Western Jumna Canal have resulted in a chronic state of famine and distress. The Provincial Government has for some time been exercised as to the means by which this state of things can be remedied. Several proposals have been considered for utilizing the flood waters of the river Jumna in this direction, but the supply in that river is known to be precarious at the best of times. The drainage area of the river Jumna is a very small one and is characterised by very steep slopes. The result is that floods of great intensity occur during short periods, but the high supplies necessary for irrigation do not hold out throughout the season. The difficulties also of bringing *kharif* supplies to the extreme end of the canal system along the existing channels are very great. For the above reasons it has been necessary to cast about for other means of bringing water to these districts. It is possible that some extensions of the Sirhind Canal system might be utilized for this purpose. The supply would of course have to be a *kharif* supply only, as the Sutlej does not carry enough water in the *rabi* to allow of any extensions of irrigation. But it is believed that if an assured supply could be given in the *kharif* season with possibly one good watering for the *rabi* sowings, the prosperity of the famine-stricken areas would be assured, or at any rate the worst evils of famine be averted. Such a scheme would require very careful examination, and there is no doubt whatever that the cost would be extremely heavy. But even to the protection of the tracts above mentioned from recurring famines would be worth almost any sum that the scheme is likely to cost. In the absence of surveys, etc., it is impossible to say how a *kharif* supply could be given from the Sirhind Canal, but possibly an extension of the Ghaggar or Choa Branches across the Ghaggar would be the simplest plan. Or if any complications with the Native States is to be avoided, possibly a branch from the Bhatinda Branch might serve for a portion of the tract. In any case it appears necessary to inquire into the scheme, as the object aimed at is of the greatest importance.

5. In the previous paragraphs four main projects for extensions of irrigation have been referred to; these are—

I.—To carry the waters of the Jhelum and Chenab to the Montgomery Bar.

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II.—To build a weir at Trimmoo at the junction of the Jhelum and Chenab and carry the waters to right and left to Uch, and through the Mooltan district, for a *kharif* supply.

III.—To convert the above *kharif* supply into a perennial supply by making a cut from the Indus entering the Jhelum at some point below Khushab.

IV.—To carry flood waters of the Sutlej *viâ* the Sirhind Canal into the Sirsa and Hissar districts.

As regards I, levels have been given in my note, dated 1st October 1902, and it is not necessary to repeat them. They show that *primâ facie* the scheme is feasible.

As regards II, a few figures can be usefully given. Of course they are merely approximations. The low weather supply in the Jhelum and Chenab at Trimmoo is about R. L. 480, the bed of the Sidhnai Canal at the head is R. L. 454, and ordinary supply level about 460. There is thus a fall of 20 feet and the distance is about 40 miles. The slope is therefore only about 6 inches a mile On this ground the proposal was once before negatived, but it was not then suggested that a weir should be built. If a weir were built, there would be no difficullty in placing the crest so as to hold up the supply level to 490, and a slope of about 30 feet could be secured which would be at the rate of 9 inches to the mile. This would be ample.

As regards III, the bed of the Indus at Kalabagh is about R. L. 666 and the bed of the Jhelum at Khushab is about R. L. 582; hence there is a fall of 84 feet in a distance of about 80 miles, or 1 foot to the mile, which is very favourable.

As regards project No. IV, levels are not at present available, but the plans show that the distance between Patiala, which is at the tail of the Feeder Line of the Sirhind Canal and Sirsa, is about 100 miles and the fall in the country is about 100 feet Hence a canal with a slope of 1 foot in the mile would be possible. The above figures have been given merely to show that the projects suggested are within the limits of possibility; of course they are merely approximations.

6. I have not yet alluded to the proposals for storage of water in the Jhelum Valley in Kashmir put forward by Mr. L. Dane, late Resident in Kashmir. The scheme appears to be a resuscitation of an old system of *bunds* which used to hold up the waters of the Woollar Lake and set free for cultivation a large area now under swamps. I have verbally discussed the matter with Mr Dane, and, as far as I could judge, the scheme appears practicable; the more so as in the old days it appeared to have been most successful. It would seem that a large area round the margin of the Woollar Lake is at present a shallow swamp and quite useless for cultivation. This area can be freed from water by means of *bunds*, the remains of which are still in existence. Suitable sluice gates, etc., can be arranged to hold up a considerable amount of water which can be allowed to discharge into the Jhelum at any time most convenient. The advantages of the scheme are that the Kashmir State will gain a great increase of revenue from the reclaimed lands, while the British Government could utilize the stored-up waters of the lake at any time they most required it. Mr. Dane also suggested a regulator at Baramulla which would hold up a considerable further supply of water The feasibility of the scheme will depend upon the levels and upon the area that can be ponded up, and I can say nothing further until I have seen the plans, etc., which Mr. Dane has promised. But there would seem to be a great deal in the project, and in my opinion it is well worth inquiring into. If any large amount of water could be stored up in the manner suggested by Mr. Dane, it is obvious that it would very materially improve the prospects of the proposal to carry the waters of the Jhelum and Chenab rivers to the Montogomery Bar.

Mr. R. C. KENNEDY, Superintending Engineer, Punjab

(*Delhi, 3rd January 1903.*)

Memorandum.

Mr. R. C. Kennedy.

There are two main points which I would venture to bring forward for the consideration of the Commission, to both of which I have paid special attention during the last twenty years. They are—

(1) The saving of some of the enormous losses of water due to absorption and waste in the various conveying channels and at the fields.

(2) The more careful measurement and distribution of water, leading eventually by slow degrees to the assessment of all water revenue by the quantity used, instead of the present haphazard and most wasteful method of payment by the area matured.

Both of these are very large and difficult subjects, and in my opinion nothing very definite will ever be

Mr. R. C. Kennedy.

attained unless some ruling dictum and impetus is given. Officials usually have no time for such things, and in the few cases when interest may be manifested the tenure of office is much too short to permit of much being done; a new man comes in who considers all such as fads. Nevertheless these two points are really by far the most important of any in the department and would pay over and over both in actual revenue increase and by the very great possible future extension of irrigated area to the more desert parts. If all was done, which is, financially speaking, possible in these two directions, the total irrigated areas in dry years could, I have no doubt, be increased by 40 to 50 per cent. over the present figures on most of the large perennial canals.

Actual absorption loss and methods hitherto taken for its minimising.

It is well enough known that only about half of the water which enters the head of any of our largest canals really reaches the fields. The same fact is acknowledged in the United States, and there the canals have not nearly so far to carry as ours have. To show that this is not merely an exaggerated statement, I give below the losses which after a whole season's experiment and collection of data were found by me and reported then to occur in the winter season of 1882-83 on the Bari Doab Canal:—

Entering canal head for each	100	cusecs.
Lost in the main canals ...	20	,,
Lost in distributaries ...	6	,,
Lost in water-courses ...	21	,,
Total absorption losses	47	,,

Out of the remaining 53 cusecs which reached the field, it was shown that 28 could really have done all the work, so that (53–28=) 25 cusecs out of the original 100 were wasted and lost in various ways. The efficiency of the canal machine was thus then only 28 per cent. Since then things have been improved on some of the main canals (not on all) and if similar experiments were now carried out, we might get an efficiency of about 35 per cent. on the best. The improvements which effected this have been mainly in the following directions:—

(1) Amalgamation of the numerous tiny water-courses into a few larger ones, so as to lessen the total lengths of channel open at any one time.

(2) Abandonment of the old system of distributary *tatils* or alternate closure of outlets, and the enlargement of each *rajbaha* so as to supply all its outlets at once for a given time, and then be closed off entirely at the head.

Work in this direction has been completed on the Western Jumna Canal; not begun on the Sirhind Canal; partially done on the Bari Doab Canal, and on the newer canals there is probably not so much room for improvement, having been designed on more recent lines.

What we can afford to spend on lining channels.

The above reforms, however, must only be regarded as preliminary to the real difficulty, *i.e.*, the prevention of the absorption loss in our improved channels. There is hence no question as to the expediency; it is merely a question of cost and means; can we prevent the loss at a cost whose interest would be paid by the increased revenue? I think it is probable we could, but Government would first have to spend something on trial and experiment, so as to find the cheapest and best methods of lining our channels, beginning of course with the water-courses.

To define the position, as far as possible, I give here two tables reproduced from a report on American Irrigation recently submitted by me, in which the probable average loss by absorption in various channels is given as a mileage rate in cusecs lost per mile—see table, column (4). These figures are for good firm loam (but not sandy) like that on the Bari Doab Canal, Chenab or upper part of the Western Jumna Canal; for sandy soil, like the Sirhind Canal, the loss will be about 2¼ times as much. Column (5) is the annual value of the water lost per mile at Rs. 900 per cusec gross revenue. Column (6) is the capitalized value of this at 30 years' purchase, and did the supply always run in the same channels, this would be the amount we could profitably spend on lining each mile. Actually, however, this is not so, and in seasons of high demand, *i.e.*, when the water is of real value in maturing the crops already sown, all the channels are not open at once, there not being nearly enough supply to fill all. Thus, roughly, in—

Western Jumna Canal, only ⅓rd of the channels would be open.

Sirhind Canal, ½ of the channels would be open.

Bari Doab Canal, ⅖ths of the channels would be open.

Chenab Canal, ¾ths of the channels would be open.

Column (6) must therefore be modified for each canal system; thus, for the Western Jumna Canal, instead of Rs. 6,000 for a 2-cusec water-course, we could only spend Rs. 6,000÷3=Rs. 2,000 per mile, and so on; for the others, allowing for the extra heavy loss on the Sirhind Canal, 2¼ times more. The small tail water-courses, only occasionally used, are outside the present discussion they could probably never be lined economically.

The Western Jumna Canal, owing to its large mileage and comparatively low supply, is the one on which we could spend least. The broad result may be stated to be that, if we can line our water-courses at a cost of from Rs. 2,000 to Rs. 3,000 per mile, it would be from a merely financial point of view advisable and justifiable to do so.

Punjab Canals. Absorption loss roughly estimated.

Discharge of channel in cusecs.	LOSSES ON VARIOUS CHANNELS BY ABSORPTION.					COST PER MILE WHICH CAN AFFORD TO SPEND ON PREVENTION				REMARKS.
	Loss in cusecs per million of square feet of surface area.	Probable surface width	Loss in cusecs per mile length of 5,000 feet.	Annual value of col. (4 @ Rs. 900 per cusec.	Capitalised value of col. (5) @ 30 years' purchase.	W. J. Canal = ⅓rd of col. (6).	Sirhind Canal = ½ × $\frac{5}{2}$ of col. (6 = $\frac{5}{4}$ of col. (6).	Bari Doab Canal = ⅖ of col. 6).	Chenab Canal = ¾ of col. (6).	
1	2	3	4	5	6	7	8	9	10	11
				Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
2	11·1	4	0·22	200	6,000	2,000	7,500	2,400	4,500	Ordinary sized water-course.
5	9·7	6	0·29	261	7,830	2,610	9,787	3,132	5,870	Large water-course.
10	8·0	7·5	0·30	270	8,100	2,700	10,120	3,240	6,075	Small minor.
20	6·4	9	0·29	261	7,830	2,610	9,787	3,132	5,870	Large minor.
50	4·1	13	0·27	243	7,290	2,430	9,110	2,916	5,467	Ordinary distributary.
100	3·5	19	0·33	297	8,910	2,970	11,130	3,564	6,682	Do. do.
200	3·1	27	0·42	378	11,340	3,870	14,170	4,536	8,505	Large do.
500	2·6	50	0·65	585	17,550	5,850	21,940	7,020	13,160	Branch canal.
1,000	2·5	65	0·81	729	21,870	7,290	27,340	8,748	16,400	Large branch.

Possible methods of lining channels.

In America so far the only means used has been cement, plaster or concrete, either laid on in a ¾″ layer on the made up section, or more recently in a machine made rectangular section literally expressed or forced out from a small machine, which itself moves on along the prepared alignment. The cost, however, is high, being in California for a very small water-course for 1 cusec Rs. 2,500, and for a large one probably about Rs. . 4,000. Moreover, being thin and weak, damage from cattle, etc., would soon result on an unprotected line. The most likely means I can think of would be the use of crude asphalte oil buried, say, 9 inches below bed and side slopes, and carried up above surface level, laid on or sprinkled on a prepared section, and then allowed to soak into the soil and then covered over. Inspection of the so-called oil roads in various parts of the states with rain-water standing for days *only* on the oiled parts seems to promise well. The permanency, cost and security from damage can only be known by experiment.

An alternative to the oil might be found in very liquid cement and fine sand sprinkled over a layer of sand and allowed to soak in, all being covered over with soil as before.

Methods of distribution and assessment now in use.

The present methods of distribution are most crude and out of date—unworthy of a department which considers itself scientific. Even with our best efforts the quantity, which a shareholder or cultivator receives, bears hardly our relation to what he ought to receive as judged by his field area or crops grown. Usually what happens is somewhat as follows. An outlet is allotted to a certain tract of land whose waterway section of orifice is roughly in proportion to the total area under command, without any regard to the velocity of exit. In a few cases attempts have been made to allow for this; but since the levels, both in the distributary and in the water-courses, are constantly liable to alteration, the results are really but little better and not worth the great extra time and trouble. This first allotment remains as it is for many years; some of the outlets do two or three times what they ought to do, and some do little or nothing, till some official with surplus energy in hand takes up the question. The shareholders who have been getting too much at once raise an outcry, and usually it is found impossible to cut them down to the correct allowance, especially as the question of land revenue formerly assessed on the basis of the area irrigated intervenes. Even when the outlet area can be at once reduced, the result is only tentative, and several remodelling schemes may possibly, one after the other, be carried out with no adequate resulting equitable system. Thus, two outlets side by side may have after many years tinkering been so adjusted as to give in normal times quite proportionately correct discharges; a dry season comes round when water must be had to save the parched crops. One set of shareholders find they can combine to clear out their water-course and do so, the levels of their land permitting a lowered level at the channel head and a greatly increased supply. The other set of men may not combine, or their land may be too high and then side by side can be witnessed two adjacent fields, the one drying up by drought, and the other with water running to waste all night, uncared for and absolutely lost. We have in fact no knowledge of how much any outlet takes off, or of what becomes of it. The existence of these evils is known and acknowledged, and need not have been here repeated were it not to point a possible remedy.

Causes of present evil system and remedy.

Of course the difficulty has lain in the want of trustworthy means of measurement. In America they are far ahead of us in this direction, but their methods will not help us much. They simply use free falls over raised sills, the record being kept and regulated by a trustworthy "water-master" selected by the shareholders themselves. Here we have usually no available fall for such sills, nor have we the man we could trust. We require automatic devices which cannot be tampered with, and which would ensure a steady supply, under all conditions of levels, strictly proportional to the work to be done. The ideal system of the future will be somewhat as follows. A distributary regulated at its head by such an arrangement as to keep the discharge quite constant at the figure required for the time being, and just sufficient to supply at once all its outlets down to the tail. As the demand fluctuated, the head supply would also be varied by another adjustment of the head gate, which would again remain automatically constant till further alteration was required.

The section of the distributary would be such at each point in its length as just enough to carry sufficient, at its designed full supply level, for all its outlets below.

Each outlet would also have an automatic device giving a constant and known discharge as regulated by the higher canal officials and based on the area to be sown. The cultivators could open and close the outlet as they desired, but could not otherwise vary the discharge, *i.e.*, they could take as much as they could get or as little as they pleased. No clearing out of water-courses, or variation in supply levels would vary the discharge, and the time open or total quantity passed through would be recorded inside. Each distributary would be opened alternately, usually for 10 days or so, and then closed entirely on a well-considered system of rotation for the whole canal, so that in times of high demand at any rate when all outlets would be open the total quantity delivered to each outlet would be almost a known quantity, even without any self-registration.

Such a method as sketched above would undoubtedly replace the present chaotic arrangement by a systematic and equitable system, leading to great economy in distribution. The question at once asked is, naturally, where are the requisite automatic devices? Well, that for the distributary head is already available. One has been at work for over 4 years, given no trouble at all with an error never more than ± 2 per cent. Other 5 or 6 were sanctioned nearly two years ago and their erection has just been completed.

As regards the outlet device, the matter is not so far advanced, but from recent experiments I feel pretty certain that a simple, cheap and effective design can be very soon perfected, giving all and more than has been above shown to be necessary. This is, however, not the place to go into details as regards either this one or the other.

Possibility of assessment by volume.

Once given some such system the road would be open, leading eventually to some contract system, or assessment by volume delivered No one will argue that the present assessment by area matured can last for ever. Not only does it work with immense friction and trouble to both parties (especially the zamindar), but it is very costly and the amount paid does not necessarily bear any relation to the quantity used. Thus, often enough such heavy floodings may be applied as to partly destroy the crop, and application is then made and often approved for remission of canal revenue.

Of course such a revolution would have to come in very gradually in the course of years; and the methods of introduction would have to be very carefully considered. Many difficulties would arise only to be eventually surmounted by patience and the slow education of the zamindars.

Of many possible methods, the following may be perhaps outlined, merely as showing possibilities. Each outlet would be rated at so much in value in rupees per hour running. This rate *might* be varied: low in seasons of no demand and high in high demand and low supply.

On each outlet a list of shareholders would be made showing the shares of each and the number of hours to which each was entitled in the ten days' rotation. Normally the water passed would be distributed proportionately to this list and assessed in the same way on individuals, *the onus of proof for any necessary alteration in distribution or assessment resting with the shareholders.* If during any alternating cycle of supply any shareholder could not or did not obtain his share, he would have to report so *at once*, and at the end of the ten days the matter would be inquired into and the corrected allotment by hours entered up in the village list, this being thus kept up to date and open to the inspection of all, instead of being left till the end of each crop. If a man's share was forcibly appropriated by another, its value would be assessed on the latter at a punitive rate. If others refused to give evidence, and the state of the claimant's field bore out his statement, then the fine would be rateably assessed on all the others. If by persistent theft any man's crop was ruined, the whole of his rates would be remitted and charged to the others. If in a very dry season sufficient water could not be given to fully mature the crops, remission would be given, preferably by a general reduction of the rate per hour or in special cases by individual remissions, thus bringing within measurable distance a solution

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of that difficult question *kharaba* or remission for crop failures.

If the shareholders as *a whole* desired alteration in the share-list, either for any special rotation or at the beginning of a crop, they would have to notify it beforehand, and if they desired no supply for a considerable period, they would have to record the same to prevent possible disputes. The zilladar or sub-divisional officer at each inspection would open the locked outlet and read the recorded register of discharge passed, comparing the same with the patwaris' books and time the channel had been open at the head with a known discharge; as an additional check, the patwaris would twice daily enter up after inspection whether each outlet was open or shut. In some cases the levels might not (unless the water-course was kept constantly clear) admit of full supply being always given; but the record would in any case show the *actual* quantity passed through; and the need of clearing out the water-course would be shown automatically by mere inspection of the outside of the outlet device. Usually the shareholders could close or open the outlet at pleasure unless specially locked, but variation of the adjusted discharge could only be effected by the zilladar or sub-divisional officer and would in fact but seldom be necessary or advisable. At first the unit of assessment would have to be on the individual; later on, as the system came to be understood, on the family holding; then on the village sub-divisions; and, finally, when local education permits perhaps on the village as a whole

A variation on the above idea might be somewhat on the plan common in the United States of contracting to deliver a definite quantity of water to each outlet proportionate to the area it ought to irrigate each crop, assessment being distributed according to a fixed share list on individuals. This may sound at first quite distinct from the first plan just detailed, but in actuality it would work out to much the same result.

Many other plans could be doubtless suggested, but what is wanted in the meantime is to prepare the means for this very desirable end, *i.e.*, complete and introduce the requisite mechanical devices at the head of each distributary and at each outlet.

Summary.

To recapitulate the points to which attention is here drawn are very briefly as follows:—

(1) The present method of distribution is extremely inefficient and out of date; a remedy is possible at comparatively speaking small cost and would result in increasing the present canal "efficiency" (regarded as a machine) from 30 or 35% to 40 or 45% and lead eventually to a system of assessment by volume.

(2) The immense loss by absorption can be much reduced by lining channels at a cost certainly high, but probably not disproportionately so to the benefit accruing. Experiments on a considerable scale would first be required. The increase of efficiency to be expected would be proportional to the capital laid out and might eventually reach a very high figure, up to 50% in place of the existing 30 or 35%.

An authoritative ruling on both points is required; without this the present system may last for another generation.

1. *Q.* (*The President.*)—You have now been appointed Chief Engineer in Bengal?—Yes.

2. *Q.* You have been lately touring in America?—Yes, I was deputed to study irrigation matters there. I went home on furlough and applied for permission to visit America.

3. *Q.* I see your paper has reference to saving some of the enormous loss of water due to absorption and waste in the various channels; and to the other most important matter of careful measurements and distribution of water, leading by slow degrees to a lower assessment of the quantity used. Was the loss you give on the Bari Doab Canal founded on a great number of discharges?—Yes

4. *Q.* You have a fair degree of certainty about them?—Yes, the range of error is probably not more than 10 per cent.

5. *Q* The loss on the main canal is 20 per cent. and on the distributary 10 per cent.?—On that particular canal there was a large loss on the main line, because of boulder and shingle, whereas the distributaries were mostly in good soil?—A canal taken from below the boulder line such as the Lower Ganges Canal and the Agra Canal would not be subject to the same loss?—Not on the main canal.

6. *Q.* Have you experimented with the water-courses?—Yes. The loss is certainly greatest there and the remedy simplest.

7. *Q.* But they are not in the hands of Government? The cultivator would not object to our lining them. We would have to guard against damage by cattle.

8. *Q.* Have you ever tried anything in the way of puddling?—So far as I know it has never been tried. It is possible in places where you can get the clay, but would be very expensive. Ordinarily the supply of suitable clay would be limited.

9. *Q.* Would you suggest that this matter be systematically followed and experiments made with as little delay as possible?—Yes, and the crude oil suggested might be given an early trial.

10. *Q.* As to the second question, the sale of water by volume, you say, "we have already arrived at a system for gauging water entering the distributaries"?—Yes. There are six or seven of my modules working in the Punjab on the Jhind distributaries.

11. *Q.* Have they given satisfaction?—One has been working for four years and has given satisfaction. The error is never more than 2 per cent.

12. *Q.* Was the tract in Jhind to be supplied with so many cubic feet?—Yes.

12*a*. *Q.* And until this system came into vogue they were really getting double the amount; they ought to have had?—Yes, fifty per cent. more at any rate.

13. *Q.* Did you see any modules in America likely to be useful to our Indian water-courses?—No, none that would suit us.

14. *Q.* (*Sir Thomas Higham.*)—With regard to these percentages, the last you worked out was in 1882-83. How was the figure of 20 per cent. in the main canal arrived at?—By actual experiments of the loss on certain lengths of canal of a given width. Some of the figures were based on your own observations.

15. *Q.* My observations were made in 1873. We took the discharge at the head and at a certain point lower down, taking precaution to have every distributary closed. Was that done in 1882?—Yes.

16. *Q.* Does not the depth of water make a difference?—Yes, but only a slight difference.

17. *Q.* Do you suppose the rate of loss is fairly uniform in every mile?—No, it would vary with different soils. In the case of distributaries I had a length of channel ponded up and observed the daily fall and absorption in terms of the water surface. The loss increased as we went down the distributary where they got water less often.

18. *Q.* Your absorption was in terms of the water-surface; what was in the loss per mile on square foot?—It was ·01 to 015 feet in depth per hour over the whole surface.

19. *Q.* How do the American figures for their loss on the road compare with our Indian figures?—Roughly they estimated that they lose something over 50 per cent. before the water gets to the fields. The figures are rather rough.

20. *Q.* You say, if we are to line channels, we must begin with the water-courses. Why?—Because they are easiest to do and the loss there is greatest.

21. *Q.* Would it not cost a great deal more per mile to line a thousand water-courses carrying two cusecs than a main canal containing 2,000 cusecs?—I cannot say, and no one can say at present.

22. *Q.* The great objection to lining water-courses is the subsequent maintenance of which you say nothing?—It would have to be done, so that they should require no maintenance.

23. *Q.* After spending lakhs of rupees on lining water-courses your difficulties begin; you have to keep up that lining ever after. Who would do that; the cultivator or Government?—Government, I expect, but quite possibly maintenance might be very small if a good method was found.

24. *Q.* Whereas in your main lines of distributaries your loss can be localised?—One would have to find out whether water-courses were worth lining or not. But on the main lines there are very few cases where the loss is much greater in one place than another; excess loss would be hard to localise.

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25. *Q.* There are certain parts in the Western Jumna Canal where there is a great deal of percolation outside the banks; would you not save more by taking a place like that in hand than by trying to work on some hundreds of miles of water-courses?—Yes, certainly, but such places are limited. It would in each case be a question as to cost and water saved.

26. *Q.* With regard to this Jhind distributary, a certain supply has been apportioned them. How much?—285 cusecs, and they always take the full supply.

27. *Q.* They used to get it almost continuously?—Yes, and now they get it intermittently.

28. *Q.* And still only 285?—Yes.

29. *Q.* Would not that naturally lead to a great decrease in the area of irrigation as appears to be the case?—Yes.

30. *Q.* When you have your module at the head of the distributaries, you will want to put in small modules at the head of the water-courses. What is the discharge of a water-course?—Anything from half a cubic foot up to 5 as a maximum.

31. *Q.* How much irrigation do you get per cusec at the head of a water-course?—300 acres per year, including both crops.

32. *Q.* So you will want modules for areas varying from 150 to 1,500 acres?—That could be managed.

33. *Q.* The area to be served is divided between a great many different proprietors?—Yes.

34. *Q.* Different villages?—Seldom. We would not have two villages on one module if we could avoid it, but several modules, perhaps, in one village.

35. *Q.* How are you to keep the peace between the owners on one module?—We can use the present share list of the village for distributing by time and rotation.

36. *Q.* Your small man on the water-course may have to pay for his share of the water and get nothing like his share?—Then he would have to say so at the time and his revenue would be assessed on the other man who stole his supply.

37. *Q.* You would have just as much to do to regulate the distribution between the various classes as at present. In America where they sell by volume what is the unit of charge; I suppose each module has a separate estate?—As far as possible; but in some cases it is roughly divided by a board. Any such regulation we would require would be very much less than at present.

38. *Q.* An American farmer is quite able to look after his own interests and he can get expert advice to prove a case against the canal administration. Here your module will be giving water to 20 or 30 proprietors who are also totally ignorant of all questions of distribution of water and they have no means of bringing it home to the canal administration?—The thing would record itself as to quantity given and the share list properly enforced would do the rest.

39. *Q.* But suppose they dispute your record?—You will never convince them you are giving them their share.

40. *Q.* The American can be convinced?—But many of the American farmers even do not know how to measure water. Their system is a very rough one.

41. *Q.* If you give an intermittent supply of 200 cusecs and adjust your modules all along, people can take the water or not as they like?—Yes.

42. *Q.* They would not take it when they did not want it?—No.

43. *Q.* Consequently you may have all the water going down to the tail of the distributary. What will become of it then?—You would have to shut off at the head just as now when a shower of rain falls, *i.e.*, you would have to readjust the module.

44. *Q.* You say people are in the habit, under the present system of charge, of taking so much water that they flood their crops, and remissions have to be given for flooding. Does that really take place?—In some cases.

45. *Q.* But you base your case upon this?—No, that is only mentioned.

46. *Q.* Would a man take habitually more water than he wants?—No, occasionally.

47. *Q.* In a season of stress when every one wants water (which is the period we have to consider on a canal) does not every one try to make it go as far as it will, the time being limited? What is the superior inducement when the charge is by volume?—We save all the trouble of measurement of area.

48. *Q.* But the inducement to economy?—Each outlet would then get its proper share. Now many outlets get double what they should, especially in famine time, when one water-course may be cleared of silt and so draw double its normal and legitimate supply.

49. *Q.* You could maintain your present system of charging by area and regulate by your modules the supply to the outlet, so that each gets its share? I grant that advantage of your module, but what I am doubtful about is the advantage or possibility of charging on the quantity supplied, instead of the area irrigated?—It would save immense trouble and friction if ever found possible, but the primary and main object of the system is equalisation of distribution.

50. *Q.* You will have to do your measurements to settle disputes between the various owners?—Only in certain cases. The civil *patwari* can do it for statistical purposes.

51. *Q.* Which is the most valuable—our statistics, or the revenues?—Ours.

52. *Q.* Your statistics would lose half their value when not founded on the basis of demand?—Not so much as that. They might be 10 per cent. out.

53. *Q.* Have you designed a water-course module?—Yes, but it is not complete.

54. *Q.* Can it be set to give any required discharge?—Yes, within limits.

55. *Q.* To set it would be a new duty for the subordinate establishment?—Yes, it would be set once for a whole season according to the area it ought to irrigate with its particular discharge.

56. *Q.* And it must be set on the supposition that you are going to run so many days in the month?—Yes, you could estimate the average duty.

57. *Q.* Supposing your supply in the main canal fails?—You must reduce the supply all round.

58. *Q.* So that will not really be paying by quantity?—If one had to give them too little, one would have to decrease the rate charged if there was not enough to mature the crops as is done now by remissions.

59. *Q.* If instead of giving water for 15 you gave it for 10, would you decrease the rate by 33 per cent.? We are coming to the weak point of selling by volume. It is that usually the value of water varies inversely to the quantity given?—One might keep the rate the same or increase it. If it is more valuable you would charge more per cusec so long as you matured the crops, these latter being then more valuable.

60. *Q.* And suppose a man's crops were not matured after all?—You would have to let him off payment as at present.

61. *Q.* You would then want your measuring establishment just as you do now?—Yes, but not nearly so much as at present.

Supplementary note.

The following points were not made clear at the oral inquiry:—

(1) In making experiments on lining channels, the use of crude oil should be gone into, possibly it might prove useful and need little or no maintenance.

(2) The assessment by volume was not put forward as *now* possible; it can only be so in the rather distant future.

The use of automatic devices giving known discharges would at once equalise distribution; whereas at present, even when there is a water famine, there are innumerable cases where the supply is far in excess of real requirements and immense waste goes on steadily. *Afterwards*—in *many* years probably—the same devices could be gradually made use of for assessment by volume, if then found feasible.

The objection that the value of water varies and is inversely as the supply could then be met by the simple device of varying the rate charged; thus in wet times an outlet might be rated at Rs. 4 per day and in dry times at Rs. 5 or Rs. 6 per day. Volumetric assessment is, however, not the *immediate aim* of any modules which might be used, only a future possibility, only attainable by the aid of such devices.

BOMBAY.

Mr. E. F. Dawson.

Mr. E. F. Dawson, Superintending Engineer, Indus Left Bank Division

(*Sukkur, 5th November 1901.*)

Memoranda.

No. I.—Preliminary note on the proposed Bukkur weir by Mr E. F. Dawson.

With reference to the questions asked about a Bukkur weir, I am still not in a position to say whether it is practicable or not. Inquiries are, however, proceeding, and I hope to know more about the site before the Commission reach Sukkur next month.

In the meantime, inquiries should proceed regarding possible increase in revenue, if the weir is practicable and is ever built. Very approximate figures will suffice in order to enable us and the Irrigation Commission to decide whether the scheme is worth proper investigation. That is all that is proposed now. I am not proposing a weir yet. This is merely our preliminary inquiry to get some idea of the revenue reasonably to be expected and the return it would yield on the probable costs.

For the present, then, let us assume the weir is practicable; that there will be no practicable engineering difficulties which cannot be overcome. I will, in the course of the next week or so, have completed an estimate of approximate figures of cost.

Meantime, to form any opinion of the return the project should give, it would help if the revenue were considered. Messrs. Rieu and Tupper should be able to assist. The Commissioner's knowledge of the country is, I understand, also considerable.

The work under consideration is a low weir of solid masonry on which to construct falling gates. With gates up we would have the water in the river at Sukkur always standing at or above 12·5 ft. on the Bukkur gauge. In the flood season, the gates—a part of them—would be dropped, and we would always maintain the river at the present average height of Bukkur or above it—something over 13 ft. on Bukkur,—and maximum floods might rise to 21 or even 22 ft. Bukkur as compared with the present maximum of 18 ft. Of course *bunds*, etc., will be raised to stand this increased flood height. The danger this might expose us to will be considered hereafter, but please neglect it for the present. We are assuming the scheme as practicable just now.

Here, then, are the conditions for the purpose of revenue estimate.

A 12-ft. weir at Bukkur will have effect as follows on the Sind Wah:—

When now, on about 10th May, we get a foot of water on the sill of the canal, the weir will raise the level to 1·66. (Trivial.)

On 1st June, in average years, we have 3·50 ft. on the Sind Wah gauge. With the weir, it will be increased to 4·90—say, 5 ft. (Important increase.)

On 28th June we have now 6-ft. With weir this will be increased to 8-ft. (Important increase.)

The weir will render us practically independent of changes in the mouth of the Sind Wah. It will not, however, *increase* the supply in July and August; the present supply would be maintained then. Little more can be said than this.

The early supply would be assured, and supply in July and August remain practically unaltered.

The weir will convert the Sukkur Canal into a perennial canal, and have an excellent supply throughout the whole year.

A new head from above the weir to the Ghar will convert the Ghar into a perennial canal. It might take a line somewhat as shown on the accompanying tracing, and would not only give water to a large tract which has suffered of late years, but would render the Ghar practically independent of changes in the river at the mouth of the Ghar, and should suffice for an area much in excess of any area ever yet cultivated.

No. II.—Note by Mr. Dawson on the proposed weir at Bukkur.

Three questions, Nos. 10, 11 and 12, have been asked concerning a weir at Bukkur. I take No. 11 first.

11.—"*What canals would be benefited by the construction of such a weir, and to what extent?*"

The Ghar, Sukkur, and Sind Canals on the right bank and the whole Jamrao and Eastern Nara systems on the left bank would be benefited. With a weir at Sukkur, it will probably also be advisable to re-consider a project for a better supply to the Khairpur State and the Hyderabad district, Mr. Joyner's Hyderabad Canals project having been condemned partly because the water was carried for a great distance at a considerable depth below the surface of the ground.

2. With a weir at Sukkur, the Ghar and Sukkur Canals (with a new feeder to the former from above the weir) would be converted into perennial canals, and be rendered capable of annually irrigating a combined area of *kharif* and *rabi* at least equal to, if not considerably greater than, the sum of the greatest *kharif* and *rabi* areas ever yet irrigated. The Sind Wah, being nearly 30 miles up river, would be only slightly improved, but there is no doubt that it would be improved to the extent of having a better early supply and also a somewhat better late supply than at present.

3. The present supply to the Jamrao and Eastern Nara systems is taken off from the river above Bukkur through the Nara Supply Channel and is ample for requirements, except, perhaps, in a low river. It was deepened in 1892 and is supposed to be sufficient, but from the fact that *kharif* crops on the Jamrao are now being irrigated by rotation in this the second year of cultivation under the Jamrao, it may not unreasonably be concluded that a limit to extensions on the Jamrao and Eastern Nara systems will soon be reached. The Jamrao is, however, already irrigating nearly the full duty of the water it can carry, so that there is no fear that the present supply channel is not capable of fulfilling its intentions; but if floods can be cut off from the Eastern Nara Valley, there is room for considerable extension of cultivation there, and, were a weir constructed at Sukkur, the whole of this area and that under the Jamrao would be rendered independent of fluctuations in the height of the river supply.

4. The increase in revenue these improvements will yield is a question for careful inquiry. It may possibly be roughly estimated by the revenue officials without much difficulty for the right bank of the river, and the Commissioner in Sind will, perhaps, be able to answer the question before the Irrigation Commission visit Sukkur, but it may safely be said that it will amount to lakhs of rupees on the Sind, Sukkur and Ghar Canals alone; and, even neglecting the left bank improvements altogether, it appears at first sight, at any rate, that a project for the weir is worth investigating further.

5. I take question 10 next.

10.—"*Has the necessity for a weir at Bukkur as proposed by Sir Evan James been felt?*"

The Ghar and Sukkur Canals, two of our most important revenue-yielders in Sind, have for years shown great fluctuations in irrigated areas consequent on variation of heights of water in the river at different seasons of the year and the Ghar has suffered also, particularly of late years, from changes in the *dhand* supply where it takes off from the river. Indeed, complaints have been so loud and real, especially as regards the higher areas near the mouth of the canal, that the Irrigation Department contemplate undertaking a survey with the object of completely remodelling the canal. Though, however, large additional areas may be brought under cultivation by a remodelled canal, it is rather improbable that the higher lands near the mouth of the Ghar will receive benefit from such a scheme so long as a mouth is taken direct from the river anywhere below Sukkur. Even a mouth from above Sukkur would not appreciably improve the present conditions, as the natural levels do not permit of it, unless a weir be constructed to raise the supply level at the head, and the only way in which the higher lands of the Ghar can be made independent of the changes at the mouth and of unfavourable falls in heights of the river is by the construction of such a weir.

6. In so far, then, as improvement in the supply has been known to be desirable on both the Sukkur and Ghar Canals, the necessity for a weir at Bukkur seems to have been recognised for years. Indeed, so long ago as 1855, Lieutenant Fife, R.E., proposed taking off a new head from above Sukkur for the Ghar Canal, but it would appear that the over-worked Engineers in Sind have never had time to spare for the investigation of a project for a weir; and the site has, I believe, generally been supposed to be extremely unsuitable and difficult, if not impossible, for that object. I have more than once been informed that there was a hole in the river-bed of the Rohri gorge which has never been bottomed by soundings. This brings me to question No. 12.

Mr. E. F. Dawson.

7. 12.—"*Have any investigations been made to show the practicability of such a weir?*"

8. Last season, Mr. Corbett, Executive Engineer, Indus River District, and I sounded the Rohri side channel from a launch, and seemed to find bottom all the way through it, the deepest sounding recorded being 68 feet, and a few soundings taken across the channel above the gorge apparently gave rock bottom at depths in most places less than 30 feet and in many places only a few feet below low-water level. Further investigation could not be made before the inundation season, and it was postponed until this cold weather. I have now had a hurried cross section taken on a line between the heads of the Sukkur Canal and Nara Supply Channel and attach herewith plan and section, sheet No. 1, showing results. There has been no time for reliable borings to be made, and the bottom rock has been found merely by sounding and by probing with an iron shod bamboo and with a long iron bar under difficult conditions, with the river 6 feet on the gauge, so the depths shown may be somewhat inaccurate; but there seems no doubt that rock can be found on this line at approximate depths given on the cross section, which are soundings below a stage of 6 feet on the Bukkur gauge. There is uncertainty about parts of the section shown dotted.

9. Much more favourable conditions may exist—the deep hole shown on the section may die out a few hundred feet up-stream; but without a complete survey of the bed of the river for some hundreds of feet up and down stream, there can be no certainty of this, and I therefore propose at this stage of the inquiry to assume that the section is as plotted.

10. Starting from the Sukkur side, we find rock at depths of from 1 to 8½ feet below the zero of the Bukkur gauge for a distance of 2,400 feet; from 8½ feet at 2,400 it drops to about 36 feet at chainage 2,600; and from 3,100 it rises to 9 feet at 3,300; and onwards it gradually rises until the Bukkur zero is met at chainage 4,600. With the exception of the deep portion between 2,400 and 3,300, there would be no serious difficulty in putting in the foundations for a weir, although parts of it might have to be done under compressed air in suitable caissons. But whether the 900 feet length in deeper water could also be satisfactorily dealt with is a question for more serious consideration.

11. Before discussing this point, however, I propose to briefly review the whole project. There are difficulties attending it which are inter-dependent with the weir design.

12. For the present, let us assume that foundations can be laid on this site, and that we can construct on them a solid weir up to 3 feet on the Bukkur gauge. Above this, we will provide a weir or dam fitted with suitable openings (regulated by gates) for the passage of floods.

13. The calculations to find the effect of the weir on low and high river water levels involve fixing data regarding height at which certain discharges occur, their sectional areas, velocities, etc., all of which are given in the attached "Calculations." All of the important data have been obtained from results of discharges measured in the last two years and from gauge heights of which we have a record for over 40 years to refer to. The lowest discharge for calculation purposes has been taken at 50,000 cubic feet per second and the highest at 800,000 cubic feet per second. The latter is supposed to occur without a weir at 18 feet on the Bukkur gauge—a height which has never been realised; and although the discharge at such a height might quite possibly exceed even 80,000, it will not seriously affect the design, the *height* at which the maximum flood is fixed being the important feature for that purpose.

14. The calculations show, with weir solid to height of 3 feet on the Bukkur gauge and with moveable gates of 9 feet height above this for width of 4,400 feet, that the following will be attained:—

> Immediately above the weir the low-water level will be permanently raised to 12·5 feet on the Bukkur gauge. It will gradually rise as the discharge increases on the river, and can be maintained by regulation of the gates at a height of 18 feet on Bukkur at all times when the river's discharge exceeds 200,000 cubic feet per second. (In practice, it would not probably be necessary to maintain this height; the gates will be lowered to maintain the water level only at height required by canal head-works.) The maximum flood discharge with gates open would pass over or through the weir at a height up-stream of the weir of 20·25 feet and down-stream at a height of 18 feet on the Bukkur gauge, *i.e.*, the construction of the weir will cause a rise in the maximum flood level at the weir site of 2·25 feet. (Of course, if gates can be provided at a lower level than referred to, this flood level will be lowered. However, the estimates for protective embankments, etc., are at present framed, to be on the safe side, on this assumption.) *At the Sind Canal*, which is about 30 miles up-stream in low river and 25 or under in high water, the effect of the weir will be as follows:—

> Where now we get one foot above sill on 10th May, we would have, with gates closed on the Bukkur weir, 1·65 on the Sind Canal. On 1st June, with an average river, we now have 3·5 on the Sind Canal and with the weir we would have 4·90.

> On 29th June we have 6 feet on the Sind Canal, and with the weir we would get 8 feet. Thereafter, gates would probably be opened, and levels in July and August would be much the same, but slightly higher than at present. The weir would have practically no effect on the Bagari or any canal north of the Sind; but it would give a permanent full supply for the Sukkur, and, with a new head or feeder from above it for the Ghar, would convert the latter as well as the former into perennial canals.

15. Attached sheet No. 2 shows the hydrographs of the river after construction of the weir at Sukkur, and the Sind Canal, as compared with averages of the last ten years.

16. Sheet No. 3 is a general map of the country, showing weir site, lines of protective embankment up-stream, and alternative lines for feeders of the Ghar Canal. The latter have been shown without any preparatory survey of the country, and are, of course, only approximate; but they serve as the basis of an approximate estimate of cost.

17. The first difficulty that arises is to select a suitable head for the Ghar feeder. It must, if possible, be placed near the weir to secure its permanency; and with this object it will be advisable to provide under-sluices on the Sukkur side of the weir itself. There will probably be some difficulty in this, and it may have to be combined with a new head for the Sukkur Canal, but no definite opinion can be expressed on this point until proper surveys have been made and designs considered. Plan sheet No. 4 is the only information at present available which gives useful information on this point. It is probable that a suitable regulator in rock can be designed. If not, it will be necessary to consider the alternative of placing the regulator in the band line to the westward, but this would probably necessitate permanently maintaining a suitable dredger to keep open its feeder channel from the river.

18. This alternative would, however, have the very serious objection that the in-drought of such a large volume as this canal would carry, namely, 6 to 7 thousand cubic feet per second, might seriously endanger the safety of the band itself, and also tend to encourage the admittedly possible catastrophe of the river out-flanking Sukkur. Such a disaster is not at all likely to occur under existing conditions, with river bed levels at Sukkur well below the surrounding country; but, with the altered conditions of a weir blocking the lower levels of the discharge section of the main channel, it is not at all difficult to conceive circumstances which would render the turning of the river not only quite possible but probable. For instance, I believe, while there should be no difficulty in constructing suitable river embankments up-stream of the weir to withstand any chance of being breached merely by water pressure that, if the river happened to take a decided trend towards the right bank, the correction of this tendency with raised bed level at the weir site might involve an expenditure of enormous sums in the maintenance of suitable training and protective works, which, if unsuccessful in the early stage, would threaten disaster to the whole scheme.

19. I might dilate at considerable length on the possible dangers the river might threaten with altered conditions of bed such as have been considered up to this point; but it will be sufficient to state that, with the small amount of consideration I have been able to give the scheme up to

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the present, I would not be prepared to recommend the construction of a solid weir up to the level of 3 feet on Bukkur. This height has been chosen for the purpose of preliminary calculations of flood levels, etc., merely because at first sight it seemed suitable for that purpose.

20. The obvious conclusion is under-sluices in the weir must be provided in order to prevent interference with existing conditions of flood and water levels as little as possible. Whether suitable sluices can be built at the depths necessary to secure this object is not so easily answered. It is a most interesting subject for consideration and discussion, but for the present I propose to proceed with my general review, assuming for the time being that the engineering difficulties are surmountable.

21. *Estimate.*—The project will include the following:—

(1) A weir or dam across the river so designed with under-sluices as to interfere with the height of flood discharges as little as possible, and also provided with under-sluices on both the Sukkur and Rohri sides of the river to secure a scour in front of the heads of the Ghar and Sukkur Canals on the Sukkur side and the head of the Nara Supply Channel on the Rohri side.

(2) A lock on the Rohri side of the river for the passage of boats and steamers.

(3) Protective embankments on each side of the river up-stream of the weir, suitable cross-section to safely withstand continued water pressure due to the maximum flood. The section chosen is as follows:—Top bank of 10 feet; top width at 6 feet above flood level; water and outside slopes 4 and 3 to 1, respectively, with an extra berm of 20 feet width at level of 2 feet below top water level added to the outside of the section.

(4) Head regulators for the Sukkur and Ghar Canals.

(5) Feeder for the Ghar Canal, capable of carrying a supply of 7,000 cubic feet per second.

22. The cross-section for the weir has 16 feet width at 3 feet above the zero of the Bukkur gauge with down-stream batter of 1 in 4 for a depth of 20 feet, and below that an increased batter of 1 in 3, which gives a width of 25·25 feet at 30 feet below the Bukkur zero. Allowing 2 feet for foundations, the whole quantity of masonry taken solid up to 3 feet on the Bukkur gauge amounts to 1,123,776 cubic feet. The openings for under-sluices will save at least half of the quantity above the foundations, but, to provide for a better class of facings, quoins, etc., at openings, one-third only is deducted. The total quantity up to 3 feet on the Bukkur gauge will then be 821,260 cubic feet, which is estimated at a rate of Rs. 150 per 100 cubic feet. Excavation for foundations is also taken at this rate. Both rates are practically double those at which the same classes of work could be done above water, and should be ample in any circumstances, even under compressed air. The flank wall is separately estimated. Above 3 feet, for estimating purposes, the weir wall is taken solid as was done below that level to simplify this approximate estimate. Rs. 4,00,000 are allowed for under-sluices. Lump sums are provided for the lock and regulator. The Ghar feeder is taken as a canal, 220 feet in width, carrying 11·75 feet of water for its whole length, half the length being taken 7 feet in embankment and the other half length altogether in cutting.

23. The estimate works out as follows:—

	Rs.
Preliminary expenses, survey, etc.	50,000
Land compensation	3,40,232
Weir	28,88,970
Lock	5,25,000
Protective embankment	11,42,576
Regulator, Sukkur and Ghar	5,25,000
Feeder for the Ghat Canal	18,23,581
Total works	72,95,359
Establishment at 21½ per cent.	15,68,502
Tools and plant at 2 per cent.	1,45,907
Leave and pension allowances at 14 per cent. on establishment	2,19,590
Interest during construction	7,52,500
Grand Total, all charges	99,81,858

Or, say—	Rs.
Works	73,00,000
Other charges	26,82,000
GRAND TOTAL	99,82,000
Say	1,00,00,000

24. *Revenue return.*—Mr. Tupper, Acting Collector of Larkana, has written a note on the expected additional area which will be cultivated, if the Ghar is converted into a perennial canal with feeder from above the weir site. He estimates the additional revenue expected as follows:—

	Rs.
On Sukkur canal—	
Ratodero Taluka	20,000
On Ghar Canal—	
Kambar Taluka from Rs. 50,000 to Rs. 70,000, say	60,000
Nasirabad Taluka from Rs. 30,000 to Rs. 40,000, say	35,000
Larkana Taluka	20,000
Southern part of Ratodero Taluka	15,000
Total	1,50,000

25. He, however, admits that he may have under-estimated the figures. I think that this is probably the case, especially when one examines the variation in the revenue realised on the Sukkur and Ghar Canals for the past ten years. The figures have been as follows:—

Canal.	Average realised for 10 years.	Maximum realisations.	Minimum realisations.
Sukkur Canal	2,45,389	3,45,422	2,03,962
Ghar Canal	7,22,193	8,42,087	3,75,874
Total	9,67,532	11,87,509	5,79,836

The difference between maximum realisations and averages should, I am of opinion, be taken as due to this project, because by construction of the weir both canals will be rendered perennial and independent of the river, and the figure which represents this should be added to Mr. Tupper's estimate, which relates only to lands not at present brought under cultivation.

26. The figures of revenue due to the work would then be as follow:—

	Rs.
On existing areas	2,19,900
On new areas	1,50,000
Total	3,69,900

27. The Sind Canal would also receive benefit, though perhaps small; so also would the Rukan, Rani, Senro, and Janib on the Rohri side, all within a distance of ten miles above the weir. Unfortunately, I know nothing of these canals, which seem to be merely small canals taking off through sluices in the *bund* line, but owing to the large increase in higher supply which should be available at their heads, it is probable that, taken together, they may be safely calculated to yield an additional revenue of at least half a lakh of rupees. The Sind Wah and other *bund* sluices on the right bank may also be credited with another half a lakh of rupees, and adding these figures to the previous expected realisation from the Sukkur and Ghar brings the total to Rs. 4,69,900.

28. It is equivalent to a return of 6·40 per cent. on works and 4·70 per cent. on works and all other charges, including interest; and, as this revenue return takes no account of possible advantages and proportional revenue which would result on the Jamrao and Eastern Nara systems; it would appear that the project is worth fully investigating, if the Engineers consider it practicable to construct a weir at a cost anything near that at which it has been approximately estimated.

29. This points to the advisability of first getting a reliable survey of the bottom of the river, but there is no time for this before the Irrigation Commission meet at Sukkur, and it would help greatly in the solution of ques-

tions likely to arise if, while there, the Special Commission would discuss the practicability of constructing the weir or dam, assuming that the cross-section is even more unfavourable than is shown on the section submitted.

30. Statements showing results of irrigation on the Sukkur, Ghar, and Sind Canals are attached for reference.*

No. III.—Mr. J. L. Rieu, I.C.S., Collector of Shikarpur.

Khan Bahadur Pir Buksh, the Deputy Collector of Rohri, to whom I showed the papers, estimates the increase of revenue in Rohri at half a lakh. He knows the country better than I do, but I am inclined to think his estimate rather too liberal. The only canals affected on that side (apart, of course, from the Nara supply channel) are the Janib Wah and Korai. They are small canals, and nothing much is to be expected from them, while I doubt whether any important system of canals is possible. The cost would be prohibitive, and there is not much unbroken ground.

The floods in the Gaho would certainly be made more certain and of greater volume, and there would be a good deal of *rabi*. But it is very difficult to give estimates. What would really happen is that there would be more *good years* in Rohri than hitherto.

As regards the Sukkur Division, I attach Mr. MacMunn's letter. Perhaps, he rather under-estimates, or rather, I should say, is wrong in making no estimate at all. I doubt, however, whether even with a good supply in the Sind Canal, the extensive lands near the Jeban Wah in Northern Naushahro could be irrigated from that canal.

The fact is that the principal result of a weir will be to give an early rise, a steady river, and a late fall. Now, when the crops fail, Government only bears an infinitesimal proportion of the general loss; so when crops are flourishing the gain to Government (in rupees) is imperceptible almost compared to the general gain. Ultimately, no doubt, there will be actual pecuniary gain in the shape of higher rates of assessment; but at the beginning, when there are no large tracts of virgin soil to be brought under cultivation, an immediate return cannot be counted on.

No. IV.—Mr. V. C. MacMunn, I.C.S., Assistant Collector.

I do not think Mr. Dawson's scheme is meant to benefit this division much, and I do not suppose it would do so. There is a good existing supply on all the three canals—Sukkur, Sind, Begari; and the main effect of Mr. Dawson's scheme would be, perhaps, the removal of the restriction on the first of these. There is land, as Mr. Giles said, in the Drakhan-Madeji region, also about Ruk; but there is no extended area uncultivated, and none over which there is an actual lack of water, with the exception of the strip it was proposed to irrigate by the new Shikarpur Canal and the northern pieces of the Naushahro Taluka to the west, which are on the tail of long *karias* from the Begari. The Sukkur Canal would, no doubt, benefit from having a really permanent *rabi* supply, but I cannot put the benefit in figures.

On the whole, I should say that, while this division would profit, the profits would be small compared to that elsewhere, and would consist principally of advantages it is difficult to express arithmetically, *e.g.*, the one that would accrue from raising the height of water at the beginning and end of the inundation, and thus making the supply uniform.

One is forbidden to discuss the practicability of the scheme. But I would like to point out that the district between Mr. Dawson's "proposed line of bands" and the Sukkur-Begari is a very good piece of country—well populated, well cultivated. What is Mr. Dawson going to do with it? If he is going to flood it, he should be told to stop at once. But I suppose he does not mean to flood it. Why a separate supply channel? It was long ago suggested to enlarge the Sukkur Canal and feed the Ghar from it.

No. V.—Mr. H. G. Palliser, Chief Engineer, Indus Right Bank Division.

A.—Sind Canal—

	Acres.
Cultivable area commanded . .	169,000
Maximum irrigation estimated by the Executive Engineer . . .	94,000
Area remaining	75,000

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The estimated "maximum irrigation" is about 56 per cent. of the cultivable command, which agrees fairly with the combined Sukkur and Ghar Canals' figures, for which see B of this Note.

Given a higher supply in the Sind Canal, the Executive Engineer estimates that one-fourth of the "remaining area of 75,000 acres" will be irrigated, or, say, 18,800 acres, which at Rs. 3 per acre will give a gross annual revenue of Rs. 56,400.

B.—Sukkur and Ghar Canals—

	Acres.
Existing cultivable area commanded by the two canals . . .	555,000
Of which average irrigation of last 10 years (up to 1900-01) . . .	=320,000
Actual average irrigation equals 58 per cent. of cultivable command.	
Maximum area irrigated in 1894-95 was	390,000
Equal to 70 per cent. of the command.	

The above "cultivable area commanded" includes the Shahdadpur and the northern portion of the Ratodero Talukas, which are watered by the Sukkur and Ghar Canals with great difficulty and at the expense of heavy silting every year. The contour survey has conclusively shown that this particular part of the country must be taken over by the re-modelled Begari Canal, which can easily and naturally deliver ample supplies, the Begari water being at a higher level than either that of the Sukkur or the Ghar.

	Acres.
Cultivable area commanded . .	555,000
Deduct—	
Cultivable area which will be transferred to the re-modelled Begari Canal	135,000
Net cultivable area remaining .	420,000
Add—	
Cultivable area available in Gaibi Dero Jagir	81,000
Do. do. Mirzapur	18,000
Total cultivable area to be commanded by the two canals . . .	519,000

Of the 420,000 acres remaining within the Ghar and Sukkur systems, 58 per cent. seems to be actually irrigated. This, if correct, is a very high percentage indeed, and there seems to be no possibility, therefore, of *extending* irrigation within the limits of the present command.

There are, however, 100,000 acres of *jagir* land which could be brought under command of the (extended) canals. Calculating on the high proportion of 50 per cent., there would be 50,000 acres of new irrigation, yielding, say, Rs. 50,000 gross annual revenue to Government in the shape of Hakabo.

But it must be remembered that the Ghar Canal when re-modelled, after relief of its impossible duties in Shahdadpur and the north, will be quite capable of watering the *jagir* country on the west during the *kharif* season, unassisted by any new Feeder Canal from the lake caused by the Bukkur Weir.

The proposed Feeder Canal would certainly raise the *rabi* level of the Ghar to something like the present *kharif* level, and would therefore secure the extension of *rabi* cultivation. But the existing irrigation is already 58 per cent. of the whole cultivable command, and it is difficult to see how extension of irrigation can be brought about. The only result of increased *rabi* supplies would practicably be the substitution of *rabi* for some of the present *kharif* cultivation, and it is doubtful, in the first place, whether such substitution will be effected by the people to any considerable extent, and, in the second place, whether such substitution would secure any increased revenue.

In his Note, the Collector of Larkana estimates the annual increase of revenue due to improved supplies brought down by the proposed Feeder Canal from the Bukkur weir as under :—

	From Rs.	To Rs.
(i) Ratodero Taluka, north	15,000	20,000
(ii) Kambar and Nasirabad, north	50,000	70,000
(iii) Larkana, north	18,000	20,000
(iv) Ratodero Taluka, south	15,000	15,000
Total .	83,000	1,05,000

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* Not printed.

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The north Ratodero figures have been excluded from the total, as that land will be taken over by the re-modelled Begari Canal.

The estimate seems a cautious one, and agrees with my general view of the probabilities.

C.—REVENUE DUE TO SUKKUR WEIR—	Rs.
A.—Sind Canal	56,400
B.—Sukkur and Ghar Canals—	
The Collector estimates about	1,00,000
The Galbi Dero and Mirzapur *jagirs* will bring in Rs. 50,000, but the re-modelled Ghar would water this area without assistance. . .	50,000
Total *gross* revenue, say .	2,00,000

Against this must, in fairness, be set the loss of revenue from the land thrown out of cultivation on both banks of the river by the raising of the cold-weather river level by the proposed weir. It is true that such loss of revenue will be allowed for in the weir project as an indirect charge under "Capitalisation," but none the less the revenue will be lost to Sind, and must be fairly reckoned as a set-off against the increased revenue from the Sind, Sukkur, and Ghar Canals systems. What such loss is likely to be, there are at this stage no figures to show.

No. VI.—Mr. J. H. E. TUPPER, Collector of Larkana.

2. The scheme would affect 4 talukas in the Larkana Collectorate—Ratodero, Kambar, Larkana, and the northern portion of Nasirabad.

3. Improved supply in the Sukkur Canal will affect the northern portion of Ratodero Taluka only.

4. Improved supply in the Ghar will affect the southern portion of Ratodero Taluka, the whole of Kambar and Larkana, and the northern portion of Nasirabad.

5. It is apparent, therefore, that the effect likely to be exercised by the scheme on this district will be practically confined to the area commanded by the Ghar system.

6. I may observe, in passing, that the Sukkur Canal already gives both a *kharif* and a *rabi* supply, and that it is, I am told, capable of giving full supply with Sukkur gauge at 9 feet, *viz.*, 4 feet under what is usually described as "fair irrigation level" for other canals. In spite of this, the supply is at present unequal to the demand. It would appear, therefore, that what the Sukkur Canal stands in need of is increased bed width and a larger volume of water, and it is not clear from Mr. Dawson's letter that those remedies form any part of the Sukkur weir scheme. Without this, the mere raising of the water level at Sukkur to 12·5 feet all the year round will exercise a comparatively trifling effect upon the canal, so far at least as it affects this district. If the carrying capacity of the canal can be increased at the same time, and the canal kept working during practically the whole year (as it was last year and is likely to be this year), I should estimate the yearly increase of revenue from the northern portion of the Ratodero Taluka at Rs. 15,000 to Rs. 20,000, not more, since the waste area in that portion of the taluka capable of being brought under cultivation is limited.

7. Turning to the Ghar system. The conditions on this canal are widely different from those of the Sukkur. The latter is a "perennial" canal and gives a full supply with a comparatively low river; the Ghar is not a "perennial" canal and can only give full supply with a high river. The Ghar is, therefore, likely to benefit to a far greater extent than the Sukkur by acquisition of a head above the weir commanding a permanent 12-feet supply.

8. The mere conversion of the Ghar into a "perennial" canal is not likely of itself to greatly increase the area under cultivation; but if the surface level of water in the canal can be raised some 3 or 4 feet (the bed level remaining the same; this implies a greatly increased volume of water also), the whole system is capable of great development. With the Ghar, the main point would appear to be raising of the surface level. This is all-important, because the major portion of the waste land available is capable of being brought under cultivation only if it can command a "mok" (flow) supply. This land, for the most part, contains a heavy admixture either of salt or of sand. Such land can be rendered fit for cultivation with comparative ease with a plentiful "mok" supply; but if a lift supply only is available, the task would be an impossible one.

9. The land which is locally known as "asal kalrati" and as "warissi" may be left out of calculation, since it would require a great number of years and an unlimited supply of water to make it fit for the plough.

10. Other varieties of these two descriptions of soil, which contain respectively a smaller admixture of "kalar" and of sand, can be converted into good land with more or less trouble in proportion as the admixture is greater or smaller. The only requisite is a plentiful "mok" supply. The variety known as "kat kalar" especially is capable of being quickly converted into what is known as "dangachi"—an excellent rice soil.

The sandy soils, on the other hand, from "drib" downwards, are capable of conversion (*given a "mok" supply*) into the description of "latashi" or "latiari," known respectively as "gasari" and "drasari"—both excellent light soils, though not suited for rice.

11. Turning now to the talukas affected, Kambar and Nasirabad both contain large areas of saltish or sandy soils capable of conversion as above described into arable land—notably Kambar. I should say that the cultivable area of Kambar Taluka is capable, under the conditions described above, of an increase equal to one-quarter of the area at present cultivated, bringing in between Rs. 50,000 and Rs. 70,000 per annum as additional revenue.

12. As regards Nasirabad (of which the northern portion only depends on the Ghar), I have some hesitation in expressing an opinion, since it is three years since I was in charge. I should say that the taluka might be counted on for an increase of from Rs. 30,000 to Rs. 40,000 owing to a greater area under cultivation.

13. Larkana Taluka is already very heavily cultivated, and I do not consider it would be safe to speculate on an increased area under cultivation of more than six or seven thousand acres, representing an increase of, say, Rs. 20,000 in land revenue.

14. The southern half of Ratodero, which depends on the Ghar head, has suffered severely of late years, owing to the low surface level of the water. With a mouth above the weir, this would be remedied. I do not, however, think that the additional area of land which could be given out for cultivation would amount to more than 5,000 acres, representing a revenue of about Rs. 15,000.

15. I may possibly have somewhat under-estimated these figures, but I should not myself care to speculate on an increase of more than 1½ lakhs as the result of new land brought under cultivation in this district by the proposed scheme.

16. This, of course, does not take into consideration the greater profit that would accrue to the cultivator from land already under cultivation, owing to his being able to calculate upon a certain, instead of a precarious, supply. This would doubtless mean ultimate enchancement of rates, and hence greater revenue from the whole cultivated area on the canal systems concerned.

17. I would notice one more point. Mr. Dawson writes that the new scheme would render the Ghar *practically* independent of changes at its mouth. From this, I infer that the existing Ghar and Ford Wah mouths will remain, and that the mouth above the weir is intended to be merely supplementary, and will not be designed to carry the full supply required for the whole canal. If this is so, there cannot, I presume, be any intention of greatly raising the surface level of the water in the canal, since, if this were done, the existing Ghar and Ford mouths would both be converted into escapes. If the surface level is substantially raised, both Ghar and Ford mouths must cease to exist as feeders. As I have pointed out, my calculations of increased revenue are based on the assumption that the surface level of the water in the canal will be raised 3 or 4 feet. If this is not the case, the increase of revenue is not likely to be more than one-third of what I have stated.

No. VII.—Mr. H. G. PALLISER, Chief Engineer, Right Bank Division.

There are no great expanses of what may be called virgin cultivable land in this division awaiting the construction of new canals, such as was the case in the Left Bank Division previous to the commencement of the Jamrao Canal, and such as may yet remain in the Hyderabad and Thar and Parkar districts. Speaking broadly, all the cultivable waste land in the Right Bank Division can be commanded and watered by extensions of existing canals. These may be taken separately in geographical order, commencing from the north.

Mr. E. F. Dawson.

1. *Desert Canal.*—The "re-modelling" of this canal at a cost of about Rs. 11,00,000 will, it is hoped, be completed in time for the inundation of 1902. When completed, this canal will, it is believed on present information, reach its full development, and be capable of irrigating the whole of its command without probability of any feasible extension for years to come.

2. *Unhar Canal.*—Beyond extension of distributaries for watering interior command, not much can be done, as the land at the tail comes within the influence of either the Desert or the Begari Canal.

3. *Begari Canal.*—It is proposed to entirely "re-model" this canal and to extend the tail distributaries so as to irrigate the Shahdadpur and parts of Ratodero Talukas, which have hitherto suffered from inadequate supplies from the Sukkur and Ghar Canals. The Begari will deliver higher water than either of these two canals, which take off much further down the river.

It is also proposed in the "re-modelling" scheme to investigate the possibility of taking in a larger portion of the Khelat territory for irrigation across the border near Khairo Garhi.

Surveys are proceeding, and will, it is hoped, be completed this next season.

4. *Proposed Shikarpur Canal* is an alternative to the widening and extension of the Begari Canal, the merits of the two proposals being judged on the results of the surveys now in hand.

5. *Mahi Canal* (on the left bank of the river, but included in the Right Bank Division) will be completed next season at a cost of about Rs. 7,60,000. When completed, it will probably be found that there is a good deal of land at the tails of the Dehar, and of the other distributaries of the new Mahi Wah, which could be brought under command by extensions. This would involve a fresh survey and a new estimate, and can be seen to next season.

6. *Sind Canal.*—No extension is possible, beyond that of the distributaries, as the tail country comes within the sphere of either the Begari or the Sukkur Canal.

7. *Sukkur Canal.*—Some of the country at the tail, at present watered with difficulty, and at the expense of much silting, will be taken over by the re-modelled Begari. This will relieve the Sukkur, and enable it to extend its sphere of usefulness in the southern direction, thus in turn relieving the Ghar.

8. *Ghar Canal* is proposed to be entirely "re-modelled," and the preliminary contour survey was commenced last season and will, it is hoped, be completed by next hot weather. The Shahdadpur country in the north-west will be taken over by the Begari Canal, which delivers water there at a higher level, and the Ghar will then be fitted to carry out its full legitimate duties to the southwards, where the water-supply is under present conditions defective. Extensions will also be worked out so as to include the Gaibi Dero and the Mirzapur *jagirs* situated in the west under the hills, and hitherto not served by any irrigation, system. The cultivable area of these *jagirs* is believed to be about 100,000 acres.

9. *Western Nara.*—Complaints have been rife for many years past of the unsatisfactory working of this great canal, and proposals have from time to time been made for partial improvements, some of which have been carried out in fairly recent times. But experience does not encourage the continuance of such patch-work, and it is now proposed to institute an exhaustive inquiry into the whole system of irrigation, commencing with the indispensable contour survey, to show how the levels of the land lie everywhere, and then to proceed cautiously and scientifically with a complete scheme for re-modelling. A history of the canal has just been prepared, and an estimate for the contour survey is being submitted for the sanction of Government.

There are large areas within the system which receive no supply of water at all, and others with a defective supply. There is no question of extension, but of construction of new branches and re-arrangement of old ones, so as to make a complete and homogeneous system of the whole Western Nara irrigation, from the mouth near Larkana down to the Manchar Lake and Sehwan.

10. *Karachi Canals.*—From Sehwan to Kotri, the strip of cultivable land between the river and the hills is narrow, and there is no scope for any but very small extensions.

Below Jerruck, the country opens out into the deltaic formation, and both banks of the river are included in the Right Bank Division.

On the left bank, inquiries are proceeding for extensions of two small canals (Laikpur and Ali Bahar) near the Pinyari, which will bring, perhaps, 10,000 acres into cultivation. Further south, near Sujawal, there is a proposal for a new small canal (called Gungri Chabatho) which will take in about 12,000 acres of waste land; and still a little further south it is proposed to extend the Satah Canal to irrigate 6,000 acres of new land, as well as to improve the supply to existing cultivation.

On the right bank of the river, there are no actual proposals as yet for extensions, but it is thought that there will be no difficulty in bringing a few thousand acres of fresh land into cultivation.

11. The order in which the above schemes may be considered is very much the order in which they have been enumerated, except that the small projects in the Karachi Canals district can be worked up simultaneously with, but of course independently of, the larger schemes of Upper Sind.

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1. *Q.* (*The President.*)—I understand, Mr. Dawson, you are the Chief Engineer, Right Bank of this canal?—No. At present I am Superintending Engineer, Indus Left Bank Division, acting for Mr. Dunn, who is absent.

2. *Q.* How long have you been connected with these works?—I have served as Executive Engineer, Sind, 4½ years and as Engineer and Secretary, Indus River Commission, for 9 months.

3. *Q.* I suppose there is no question of famine relief works?—I think not. Last year there was a threatened scarcity caused by people coming in from Cutch.

4. *Q.* You never consider it necessary to keep up a programme of relief works?—Such is never called for. We only open so-called famine works to meet the requirements of people coming in from Cutch.

5. *Q.* The point that concerns us in the Irrigation Commission is to inquire how the irrigation system can be improved so as to add to the various food supplies required for the country. We should like your opinion on this?—My information is based on the replies given to the written questions already asked. To begin with, what strikes me is the very large area of land that is cultivable but is not cultivated or assessed, 700 square miles. I suppose you understand we have in Sind a system of fallows.

6. *Q.* Will you explain this system?—We are supposed to allow for three years' fallow and one year's cultivation. The area commanded is therefore four times at least the area that will be cultivated annually. In some ground crops are grown year after year, but ordinarily there is three years' fallow, and the revenue settlement provides for only that, calculating one-third of the area as assessment.

7. *Q.* You deliberately provide for only irrigating each year ¼ of the area?—Yes, the land won't stand irrigation every year.

8. *Q.* Had you occasion to go into that?—No; we have statistics, but our projects provide for irrigating only ¼.

9. *Q.* As the result of your observations, does it appear a reasonable thing to reserve such a large amount of fallow?—Yes, in the present condition of the people.

10. *Q.* I suppose there is no restriction. They may cultivate the whole area?—Yes. Land is assessed as lift or flow, but a man is not allowed to convert lift into flow without permission.

11. *Q.* Can you tell me approximately the relative areas of *kharif* and *rabi*?—I can't give it to you otherwise than in a blue book.

12. *Q.* I suppose the "lift" is *rabi*. You give in statement "C" the total area cultivated. I suppose the wheat crop represents the *rabi*?—Not altogether. We have a large area of Jhamba and other oil seeds.

13. *Q.* As far as water is concerned, putting aside lands under fallow, I suppose there is plenty of water for increasing the *rabi* cultivation?—No, not in our canals.

14. *Q.* In the river?—Yes, there is ample water. We have measured 34,000 cubic feet a second. That would increase as the river rises, but it is on too low a level to be

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utilized in canals. We are excavating the beds of some of the canals to give a supply at what is called the fair irrigating level. We speak of 13 feet on Bukkur as being a fair working level and it corresponds to 17 feet at Kotri. It would not pay us to deepen some canals because they would become silted early in the season. Certain of our canals are very good *rabi* ones.

15. *Q.* You mean it would not pay at the present assessment rates?—It would probably disturb our system altogether to irrigate specially for *rabi*.

16. *Q.* What is, roughly speaking, the bed slope of canals?—Usually 5″ to 1′ per mile,—sometimes *nil*; the surface slope is then given by the rise of river.

17. *Q.* What is the slope of the country?—Near the river itself it is running inland sloping 9 inches to a foot and then reduces to 4 inches per mile.

18. *Q.* Sloping away from the river?—Yes.

19. *Q.* I find in one of the papers the remark that "well irrigation need hardly be noticed—27,000 acres?"—Yes, the statement is given, but I think the Revenue Department had better explain how it is classified. I think it is due to our canals, by the water level being raised, but it has been classified as wells and not under canals.

20. *Q.* But still the wells are very largely used?—Yes.

21. *Q.* What about is the depth of spring level?—Perhaps a little back from the river face we should find water in a few feet. It follows the ground level.

22. *Q.* What is about the outside the cultivators have to raise water?—Ordinarily ten to twelve feet. But in Hyderabad our canals get very little flow; the irrigation is all lift and the wells are deeper, down to 50 feet I think. Outside the canal tracts they have deep wells up to 90 feet.

23. *Q.* Even where they are only 10 feet below the surface would cultivators prefer canal water?—I really don't know. I think they would if they got flow. We have certain restrictions on the description of cultivation to be grown. We might not allow them to grow rice on such lands.

24. *Q.* Then there is a restriction on rice?—Yes. Owing to the larger quantity of water it requires.

25. *Q.* Do the cultivators apply to the Collector for permission to grow rice?—Yes, to the Assistant Collector, who passes it on to the Engineer concerned.

26. *Q.* Is the silt which comes into your canals fertilizing of sorts?—I think not appreciable. If it puts merely a skin on the ground the people undoubtedly praise it, but I find if silt is brought by flood it often gives trouble.

27. *Q.* Have you both large and small inundation canals?—Yes.

28. *Q.* Are the small ones private property?—No. Practically all the canals in Sind are in Government charge. There are a few private ones and they are gradually being absorbed.

29. *Q.* Are those in Government charge under the Irrigation Department?—Yes.

30. *Q.* You are responsible for clearance?—Yes.

31. *Q.* What are about the maximum and minimum levels on the Bukkur and Kotri gauges?—We mark every year on a diagram the average of ten years. This diagram shows the heights. It starts in the month of January. Our present average height is about 5′ on Bukkur.

32. *Q.* That is the minimum?—No. Two feet below zero.

33. *Q.* What is the average?—About zero.

34. *Q.* What does it rise to?—Starting at zero it just touches the foot and then on to 1¼′ in February, then to 4. At the end of March and at the beginning of April it rises to 5′. At the end of May it reaches 6·9. We get a temporary rise in the middle of May. This year it went to an enormous height. At Dera Ghazi Khan it reached a maximum record. From the 1st June it rises to 11¼ at the end of June. Even on the 10th July it reaches 12⅝ and it stands at that height until the end of August. The final height it may reach varies from about 12′ to 17·9′. The minimum I have not here.

35. *Q.* Then there are variations of at least 6 ft. between the maximum in one year and the maximum of another?—We generally approach 13.

36. *Q.* Then it might be as low as 12 and it might be as high as 16?—Yes.

37. *Q.* You are engaged on the Indus Survey?—Yes. We are doing what we can.

38. *Q.* Do you go further up than your own province?—No.

39. *Q.* Would not that be necessary?—If we think there has been erosion of the river face we survey the river for a few miles above and below and leave on record possibilities of future movements. We are also measuring discharges.

40. *Q.* And taking cross sections?—Yes, depths, cross sections and velocity measurements.

41. *Q.* In your answer to question 5 "areas of irrigation, etc.," you give a table. It gives altogether the areas commanded 44,000 acres, besides which I gather there are 150,000 acres which may possibly be irrigated by proposed canals?—Yes.

42. *Q.* These are extensions which might be made to the canals?—Yes.

43. *Q.* Do you think that you will add nearly 1 million acres?—Yes.

44. *Q.* This million acres, what is it going to cost? How many lakhs of rupees?—Possibly 45 lakhs or 50. I have not got estimated figures. I am not familiar with these figures because I have only had charge of the Division for a short time.

45. *Q.* Then you say 10 lakhs of irrigation for 50 lakhs of rupees?—Yes, I think that it would be a fair estimate.

46. *Q.* According to the present system in one year you would irrigate a third or fourth of that?—I believe that is right. I am not sure of the figures. It may only be a third that we expect to get out of that.

47. *Q.* Have you had experience of land that seems to be injured by salt or *reh*?—I have had experience of it. I prefer not to mention any opinion on the subject. At Karachi we get rice, but a poor description requiring a large amount of water.

48. *Q.* To come back to private canals, are they the property of single individuals or communities?—I think of single individuals.

49. *Q.* I understand there is a very large area here under *jagir*?—Yes.

50. *Q.* Are these the men who make private canals?—Yes.

51. *Q.* As regards making new canals would you make any difference where it is *jagir* land?—Yes, because we only get a *kakabo* rate. It may be 8 annas an acre.

52. *Q.* Would you avoid such lands?—Yes.

53. *Q.* On the other hand, I suppose many of the *jagirdars* get canals by *takavi*?—Yes, I think so.

54. *Q.* It is a boon giving them free water?—Yes, that is what it comes to.

55. *Q.* Is there any irrigation in Sind done from mountain torrents in the west?—Very little; they bind up small streams.

56. *Q.* You are in favour of constructing a weir at Bukkur?—Yes, but more information is required before I can come to a final decision. Until I came to answer certain questions put by Mr. Higham we had nothing at all prepared regarding this scheme.

57. *Q.* You estimate the cost at 100 lakhs?—Yes, that includes interest.

58. *Q.* Have you any real doubt on the subject as to where the site of the weir should be. Must it be above Sukkur?—Yes; there is no other point where it could be except at Jhermak. That project was examined very carefully with a view to taking an irrigation canal to Karachi, but after examination, it was considered that it would yield no return.

59. *Q.* When you say no sites what do you mean?—No suitable foundations.

60. *Q.* Do you think there is practically no site elsewhere?—No.

61. *Q.* (*Mr. Higham.*)—The statement you have given us shows about ten thousand square miles in Sind that are irrigable, but at present not provided for by irrigation?—I have not got that statement. I have not seen it.

62. *Q*. Have you any idea what the area is that remains to be taken up?—No. I have no idea.

63. *Q*. The cultivable area is 18 million acres, of which you irrigate 2½ million acres a year?—Yes.

64. *Q*. Are you supposed to irrigate one-third of the area commanded?—Yes; we are, however, doing very much more than that on some canals.

65. *Q*. On a broad average you irrigate that?—Yes, that is what it practically amounts to.

66. *Q*. Of 7½ million acres commanded you irrigate 2½ million acres, that leaves about 5 millions?—Yes, but I don't know what the 5 million acres mean. It may include all sorts of land.

67. *Q*. What would be the result of constructing a weir and raising the level of supply to the canals on the right and left bank and giving a perennial supply?—What additional area would it enable you to bring under cultivation. What would it put on the right bank?—I estimate that on the average we might expect nearly 4 lakhs of rupees.

68. *Q*. I am talking about areas; what would be the additional area of cultivation?—About 120,000 acres on the right bank.

69. *Q*. That would be new cultivation?—Altogether new cultivation on lands which don't get water now except on rare occasions of flood.

70. *Q*. Multiply that by 3, the actual portion under command, that is, 360,000 acres, and you would improve the conditions of supply to the existing cultivation?—It would render the existing cultivation permanent and secure.

71. *Q*. What additional area would you take up on the left bank?—I don't know what the figure is, but Mr. Joyner says 300,000 acres practically would be brought under cultivation.

72. *Q*. The greater part of the left bank is in foreign territory?—Yes, Bahawalpur and Hyderabad.

73. *Q*. Would the land in Bahawalpur be under command?—It will be practically "flow" instead of "lift."

74. *Q*. I think on the left bank of the river the present irrigation is chiefly "lift"?—Yes.

75. *Q*. If you make the weir it would be flow?—Yes.

76. *Q*. What is the difference in the rates of flow and lift irrigation?—I think the rate would run Rs. 2-4-0 for lift and Rs. 3 for flow, but a smaller quantity of water would irrigate a larger quantity of land.

77. *Q*. Would it only cost 12 annas to lift the water?—Mr. Joyner estimates it would cost 12 times that.

78. *Q*. If you give flow irrigation although the revenue would not increase much the cultivator would benefit?—Yes.

79. *Q*. Is there not a large area in the Hyderabad Tahsil not irrigated at all?—Yes.

80. (*The President*.)—There is plenty of room for extension of irrigation in Sind?—Yes.

81. *Q*. If the weir is made at all you will take full value out of it?—I think so.

82. *Q*. (*Mr. Higham*.)—Is there any reason to suppose that the withdrawal of supplies from the Punjab will injuriously affect the supply in the Indus canals?—In my opinion none at present because of the cold-weather discharges. All that we require is for the Nars and the Phuleli and those which have cold-weather irrigation. I don't think it can have any effect. The Punjab canals only take 20,000 cubic feet.

83. *Q*. What is the minimum discharge of the river?—Last year we measured 35,000 cusecs. The measurements we have only had for the last two years and the discharge does not necessarily vary with the gauge.

84. *Q*. That 35,000 was measured at Kotri and the same at Sukkur?—Yes, nothing goes off between.

85. *Q*. That is exclusive of what is passing down the Nari, how much does that take?—Probably not more than 2,000 a second at this season of the year.

86. *Q*. It is immaterial?—Yes.

87. *Q*. If we take another 10,000 cusecs off in the Punjab, would not that affect this discharge?—It might affect our supply slightly.

88. *Q*. When do you open?—Between the middle and end of May.

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89. *Q*. What would your supply rise to in May?—I have shown we get 100,000 per second with a gauge of 6' on Bukkur. A withdrawal of 5,000 cusecs would not have any effect at all.

90. *Q*. Then the proposal for a weir is not with the object of preventing the retrogression of the Sind canals owing to the withdrawal of water in the Punjab?—No; the weir is required to ensure command and extend cultivation in Sind. At present, if we wish to make extensions, we must deepen the 'take off' of our canals.

91. *Q*. With your weir you will get an increase in the surface slope?—Yes.

92. *Q*. And therefore a less deposit of silt?—Yes, in the Nari, not in the canal.

93. *Q*. That would only extend a short distance because you get on natural levels again. So from consideration of this subject you think you should build a canal at Sukkur for a crore of rupees?—Yes, if it is practicable at all.

94. *Q*. What would be the advantages of it? It is unnecessary, I understand, to prevent the present canals falling back?—No; it would convert the Sukkur and Ghar into perennial canals. We would then have an area for efficient cultivation. We might have a large tract on the left bank at Hyderabad. The combined revenue from these improvements would unquestionably give us a return of more than 6 to 8 per cent. on capital cost.

95. *Q*. Assuming the cost would be a crore?—Yes. Then we would be saved all the trouble and necessity for surveys at the mouths of the Ghar and Sukkur which limit the area on account of the uncertainty of the supply, and we would also provide for extensions a great deal more than is possible at present. Opening up the Hyderabad area would be an enormous improvement.

96. *Q*. The supply would be much more constant?—Yes, it would be permanent in a sense.

97. *Q*. That would lead to an increase of assessment?—Yes, finally.

98. *Q*. In the meanwhile the average supply would be brought up to the level of the maximum?—I think so unquestionably. The real difficulty is construction, which involves masonry work with compressed air at a depth of 40 feet and provision of sluices.

99. *Q*. Might you not divert the river from one side to the other?—I think not. That is my present impression. It would be a magnificent work if it could be carried out.

100. *Q*. Are none of the canals supplied with distributaries?—Yes, they have branches.

101. *Q*. What is the length provided?—I could not answer. We have long distributaries. Down in Karachi they have very small distributaries.

102. *Q*. The water-courses belong to the villages?—Yes.

103. *Q*. What length; how many miles?—I can't give you the figures. I have not looked at them for years.

104. *Q*. (*Mr. Ibbetson*.)—Do your canals ever fail in drought?—We have scarcities.

105. *Q*. Within your experience to what would that scarcity amount; what proportion would the contracted cultivation bear to the area of crops ordinarily matured?—It might be ½ in bad years.

106. *Q*. That is a maximum?—Yes, and that would be only on specially bad canals that had something wrong with their mouths.

107. *Q*. Is very much damage done by water-logging?—There has been but practically none since the embankments were made.

108. *Q*. Have not drainage works been executed?—We have spent ¾ crore of rupees on the Jamrao. On that system they have a drainage system as part of the project.

109. *Q*. Do you think that drainage is required?—I think so in certain tracts.

110. *Q*. Has compensation ever been given within your experience for the damage done?—Never.

111. *Q*. Don't you think it would be right to give compensation when you injure a small tract for the benefit of an immense number?—I think it is the fault of the cultivator taking too much water in order to give full benefit of the silt for rice cultivation.

112. *Q*. What form does the injury take?—Marshes, etc.

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113. *Q.* Does the health of the people suffer seriously?—Fever is a result.

114. *Q.* Are the remissions considerable?—In some years.

115. *Q.* What proportion of revenue is given?—We have flood remissions and remissions for shortage of water. The latter is given on the examination of the revenue official and a village *panch*; so much by the aggregate outturn on the area concerned.

116. *Q.* If you get a four-anna crop, you would not charge half rate?—No.

117. *Q.* The assessment is made by the village *panch*?—Yes.

118. *Q.* You have nothing to say to that? Do you think that the remissions are liberal?—Yes, very liberal.

119. *Q.* What credit, direct or indirect, is made to your canals?—The whole revenue realised on the area of irrigated land, after deducting, I think, 5 per cent. for collection.

120. *Q.* The assessment is levied only on land sown; is it not?—Yes, but it is compulsory to cultivate each field periodically. A man has to pay his assessment if he does not.

121. *Q.* How far are the Sind canals provincialised?—They are all Imperial.

122. *Q.* Does the Provincial Government get no share at all of the revenue?—I think none.

123. *Q.* Do you experience any difficulty in getting money to extend canals?—There was some difficulty a few years ago, but lately we have been treated very well. At present there is a difficulty in getting funds for works classed under 43 instead of 49.

124. *Q.* That is extensions and improvements to existing canals and extending others?—Yes, we have such projects as the Hasan Ali. We may be able to spare money for 49; we have a difficulty to get it for 43.

125. *Q.* We are told that you have some ten thousand square miles of land unirrigable but irrigated. Your statement shows that $\frac{8}{24}$ of the cultivable land is irrigated and that $\frac{14}{24}$ is lying fallow. You told us also that you have schemes which would add materially to the area irrigated, and that large extensions are possible?—Yes.

126. *Q.* During the past 13 years there has been next to no increase in cultivation and next to no increase in irrigation. (Witness produced statement to explain.)

127. *Q.* Within the last 11 years have there been any large extensions?—Not very much. We have constructed a large number of works, which have, however, not yet begun to show results. The next few years ought to show a considerable increase. We have also secured stability of irrigation; the annual area fluctuates much less than formerly.

128. *Q.* Suppose you had unlimited money could you extend irrigation practically to an unlimited extent—No, to an unlimited extent. We should have to bring in labour from outside.

129. *Q.* You are doing that?—Yes.

130. *Q.* You say that a good many of the existing canals were made originally by the people, and that the private canals have been gradually absorbed. Has the process gone on in your own experience?—Yes, we have cases.

131. *Q.* Why has it been necessary to absorb them?—Owing to the neglect of the owners who had become bankrupt the lands fell out of cultivation and the people themselves appealed to Government to take the canals over.

132. *Q.* Has the existence of private rights in canals impeded progress on Government canals?—Yes. But not appreciably.

133. *Q.* In a tract where Government is not prepared to extend irrigation within the next 20 years, would it not be a good thing to stimulate the construction of private canals?—We have very few tracts in which to give out rights for private canals. There is little room for them.

134. *Q.* Has there been any trouble on private canals in the recovery of dues?—I don't know.

135. *Q.* Do you charge any royalty on private canals for the water?—I don't know. They are mostly on *jagir* lands.

136. *Q.* Do you know what the owners of the private canals take from cultivators as water-rate?—No. I think it is a share of the crop.

137. *Q.* Have you any experience of the working of the statute labour system?—I have had a few such canals in my charge, and it is thought unsatisfactory. Some men do not do their share.

138. *Q.* If the men don't finish their share of work, it has been necessary to take it over?—Yes.

139. *Q.* Is it not the case in Sind that canal water is only used to start the *rabi* which is matured by the wells?—I don't think that is the case here, although it may be to some slight extent on particular tracts.

140. *Q.* Have you any knowledge of tracts which are irrigated from wells without canal water—that are independent of wells?—No.

Mr. R. Giles.

Mr. R. Giles, Commissioner in Sind.

(Sukkur, 6th November 1901.)

1. *Q.* (*The President.*)—I understand, Mr. Giles, you have been many years in Sind?—Yes. I have been here close on 33 years.

2. *Q.* And know the whole province from end to end?—I have been in every taluka and know something of every part of the province.

3. *Q.* We are not concerned here with questions of famine relief, but it is our duty to inquire how far Sind can subscribe towards the food supply of the country and what improvements and extensions can be made in irrigation. What we wish first to ask you is to explain some points in the tables, which were sent to us which we find it difficult to understand. What chiefly strikes us is the large area (said at one place to be 10,000 square miles) not assessed and not cultivated?—It is described not quite correctly, I think, as irrigable.

4. *Q.* The figures are given in the footnote to statement "G." Mr. Muir-Mackenzie said it was estimated that 10,000 square miles of irrigable land were still left in the province?—I have gone very closely into the question and undoubtedly the word "irrigable" is wrong and should be 'cultivable,' that is, fit for cultivation whether by irrigation or rain water, wells, etc. I would prefer referring to the statement which follows G among the Revenue Statistics; with regard to every taluka, I have some knowledge and therefore I can show you by turning to one taluka only that the word cannot mean "irrigable" as it includes land irrigable by rain—land which the Tapadar (who is the lowest Revenue official) has classed as cultivable. He doesn't know whether the Indus water can be brought to it or not; the real proper expression for such land is "fit for cultivation."

5. *Q.* What do you think, with the amount of knowledge we now have, would be a safe estimate of the area in Sind uncultivated but cultivable and irrigable from the Indus?—When I was discussing it with Mr. Dawson yesterday, he said perhaps a good estimate would be a fourth of the 10,000 square miles, *i.e.*, of the 6,400,000 acres, but I think a larger area. Mr. Dawson said that his was a very rough estimate. My opinion is that the area is distinctly larger. It is quite clear that the 64 lakhs was a mistake. Take, for instance, Karachi, where the cultivable area is shown as 51,000 acres. If anything is settled, it is that Karachi will not be irrigated by the Indus. That question has been thoroughly threshed out in former years by the Engineers.

6. *Q.* By "Karachi" you mean Karachi district?—No, the taluka.

7. *Q.* There is no canal irrigation in the taluka?—None. I have a report from the Deputy Collector of the Shahbandar Division in which he says an area approaching two lakhs is irrigable in that Division alone, but yesterday I discussed this with Mr. Dawson and Mr. Summers, who was the Executive Engineer of the Canal Division from which the water would be supplied, and they were of opinion that probably 50,000 would be irrigable from the Indus.

8. *Q.* In your opinion Mr. Dawson's rough estimate of 16 lakhs as the irrigable area is low?—Yes, I think there is a large area which could still be irrigated. Mr. Dawson has not a very intimate knowledge of the province. After a short service in it he went back to the Presidency and has only just returned. He was formerly in charge of the Karachi Division, but does not know the province generally.

Mr. R. Giles.

9. *Q.* In your statement "A" there is 1,270,000 acres shown as 'alienated'; that means *jagir*?—Yes.

10. *Q.* It is a very large proportion of the province?—With regard to the *jagir* land, it has always seemed to me a pity that canals should not from the first be credited with full revenue. The whole canal revenue ought to be credited to the canals and areas which have been granted for political reasons should be a debit to their proper department.

11. *Q.* Until you have a perennial supply of course, the *rabi* irrigation will be uncertain; but do you think it would be an improvement to try the perennial or *pakka* system of head-works purely from a *kharif* point of view?—The ordinary canals in Sind have no cold-weather supply, and you can never tell what the Indus may do at their mouths. Head-works in themselves are no protection, as the river may leave them high and dry or erode them according as it wanders from one side to another. Until you have permanent heads, you can have no certainty even as regards your *kharif* crops and, as a rule, no regular *rabi* supply.

12. *Q.* A weir here would not do any good to the Begari Canal?—No. The Begari owing to its situation has worked better; it has had less bad years and suffered less than most of the canals.

13. *Q.* Do you happen to know if the Engineers have got a project for improving the irrigation of the tract of country at the tails of the Begari, Sukkur, and Ghar Canals?—Yes. There are two alternative projects, *viz.*, to increase the width of the Begari Canal, or excavate a new one to be called the Shikarpur Canal. I have written very strongly about it and I advised Government to send up an Engineer. It is very disappointing; the people have suffered for years from an unreliable and insufficient supply.

14. *Q.* All the available money has been spent on the Jamrao and Right Bank works?—Yes.

15. *Q.* There has been no large increase of irrigation (according to the statement) in the last 10 years?—That is quite true; we have had a good many bad years. 1897 and 1898 were very good years; 1895 and 1896 very bad years. We have had unusually bad years coupled with this drought, otherwise our area would have gone up very much. Then again the effect of the Jamrao is not included. In the first year the canal irrigated only 11,000 acres; in the third year there were over 175,000 acres under cultivation and 4 lakhs of revenue. These last figures correspond to the project estimate for the 7th year. The ordinary estimate in Sind is that land is cultivated once in three years. The best areas in Sind are cultivated every year, but the circumstances vary enormously. I could name a whole taluka where the land is high (under lift) and is only cultivated once in four years; but in the north of the Hyderabad district, where there is a large number of wells with good irrigation, every field is cultivated every year. There is a vast difference between different parts of Sind. In some places you have only to bring water to have the land irrigated every year.

16. *Q.* Is there well-irrigation independent of canals?—Practically none. With regard to statement "E," "the area under wells," what is put down there as well-cultivation undoubtedly gets its chief supply from the canals. Owing to the rise in the level of the water caused by the canals, I suggested that this should be altered and the area credited to the canals. Sir Evans James took a different view and therefore we left things as they were.

17. *Q.* Is there any feeling here that what is grown by the well, is better than that grown by the canal?—Certainly.

18. *Q.* What do you put that down to?—The man who has a well will ordinarily be more careful. He has to be industrious to build his well. The cultivator practically resides in the fields. The outturn would be better than the outturn of a field under ordinary flow irrigation. If I were a zamindar myself, there is nothing I should like better than to have a good tract of land irrigated by wells. I am always advising the zamindars to build wells.

19. *Q.* It is much more expensive for them? The flow rates are extraordinarily low?—That is a very big subject indeed. I have just recommended to Government that the rates for flow on the Mithrao Canal should be raised a little. Now that there is perennial irrigation there, I don't think the lift rates too high compared with the flow rates; the lift produces a better crop. Under native rule the lift paid more because the outturn was greater.

20. *Q.* Nothing is credited to the man for his own cost of lifting?—We don't charge on wells at all. We treat wells as non-existent as regards assessment.

21. *Q.* The last column of the statements of cultivation on wells shows assessment of Rs. 54,000?—The rule is this. We assess land which is irrigated by wells exactly as if the well was not there. If it gets a flow supply, we assess it at flow rates. If it gets a lift supply, we assess at lift rates. We ignore the well altogether. For instance, supposing the *rabi* crop was irrigated with canal water at the end of the flood season and received additional water from the well, we should assess the field as if irrigated by the canal only.

22. *Q.* Would you generally advocate the deepening of canals for *rabi* irrigation?—That is too much of an engineering question for me. It strikes me that the canals might silt up.

23. *Q.* You are agreed that there is a very large area still irrigable and cultivable in the province and there is lots of water in the Indus?—Yes.

24. *Q.* Supposing you had money to carry out works, would there be a difficulty about finding cultivators?—Yes, at first, but they would be forthcoming in time. The Baluchis on our frontier are howling for land. Rajputana would also send us men. There is always a want of cultivators at first. When I went to the Jamrao last year, there were very few people to cut the crops, but that was practically the first year. You must allow time.

25. *Q.* You say money is given more liberally for canals by Government now than it used to be?—Yes.

26. *Q.* What is your opinion about private canals?—There are private canals all through the province. By assuming the entire management of the canals we have spoilt the people for the construction of new private canals.

27. *Q.* Are the private canals properly looked after?—Not always.

28. *Q.* Are they the private property of individuals or communities?—Communities generally.

29. *Q.* Are people anxious for Government to take them over?—They like keeping them until there is a dispute. We go on taking over canals. We have just taken over three important canals in one taluka.

30. *Q.* With your experience of Sind do you know of places now water-logged which used to be flourishing?—The best example of this is undoubtedly the Mithrau, where water was given too profusely and a great deal of the land has become sodden and black from salt.

31. *Q.* Has this last efflorescence done much harm?—It would be difficult to say, as there are always other areas available; but as cultivation and population increase in a taluka like this (Sukkur) with villages all about, the salt lands are brought under cultivation.

32. *Q.* What is the population per square mile?—There are about 47,000 square miles and 3,200,000 of people, excluding Khairpur. Large areas of Sind are hill and desert. Roughly speaking, half of Sind is cultivable.

33. *Q.* Is the advance of irrigation here, as far as you are aware, hindered by want of establishment?—I think so.

34. *Q.* (*Mr. Ibbetson.*)—I understand, Mr. Giles, that in Sind, as the Indus supply never fails, water is plentiful and therefore famine is unknown?—Yes, except in the desert. The moment famine occurs there the people all come in except a certain number, chiefly high caste Rajputs and a few others, and the consequence is that actual famine relief work is very little indeed. It is not conducted on Famine Code principles.

35. *Q.* Of course you have good and bad years. What do you suppose, as compared with an ordinary year, the difference in the whole yield amounts to in the worst year you have knowledge of?—1895-96 was a very bad year; 1897-98 a good one. The difference in cultivation was 700,000 acres. The remissions represent only about $\frac{1}{10}$th of the total loss to the country.

36. *Q.* At any rate, though no famine is possible, yet a bad year involves an enormous loss of yield to the people which presumably might be remedied by schemes for making more certain the supply?—Yes, certainly. It will never be remediable to a large extent except by a system where a permanent supply can be given. There is no permanency in the Sind Canals except the Sukkur Canal and where you have a sure supply.

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37. *Q.* Then your system of assessment is a consolidated charge on the assessed area?—Yes, subject to remissions on poor crops assessed by the Tahsildar or Mukhtiarkar assisted by assessors.

38. *Q.* Supposing that in a survey number, the total area of which is 5 acres, there was an acre of cultivation and four acres remained uncultivated, how would you assess number?—We should take the assessment on the entire area of the number.

39. *Q.* Supposing the number was entirely uncultivated, how would you assess it?—We should take no assessment subject to the limitation that, after the number had remained four years in succession uncultivated, it would be assessed in the fifth year, whether cultivated or not.

40. *Q.* The assessment on the number in which there was cultivation would be subject to remission for poor crops?—Yes, even on the uncultivated number assessed in the fifth year remission would be given if, from any reason such as failure of water-supply, cultivation was impossible.

41. *Q.* What is your scale of remissions?—If the gross produce exceeds twice the assessment, no remission is given. If it does not, we take one-third of the produce.

42. *Q.* What proportion of the revenue is credited to canals?—90 per cent.

43. *Q.* Is that a direct or indirect credit?—It is a book credit.

44. *Q.* Do you know what share the Local Government takes?—I don't know.

45. *Q.* You tell us that private canals have been gradually absorbed?—Yes, there is still a certain number of private canals.

46. *Q.* Now in an area, where Government is not prepared to undertake works for the supply of water, would it not be a good thing to stimulate the construction of private canals?—I don't think so. The people would not make them. They are looking to us.

47. *Q.* You think nothing we could do would stimulate the construction of private canals?—No.

48. *Q.* Do we take a royalty for the use of river water?—No.

49. *Q.* Have you any power to authorise a canal being carried over the land of another man?—No. Neither do we generally help them. Yes, the Bombay Irrigation Act provides for such authority, but it is very seldom used in practice.

50. *Q.* You don't think this is an obstacle?—No.

51. *Q.* According to the Bombay rule no revenue is taken for private improvements. How do you reconcile this with taking more than one-tenth of the usual revenue on land irrigated by private canals?—Most of our private canals take out of Government canals. Private canals from the river are almost unknown.

52. *Q.* My point is this, do you think a liberal reduction should be given on account of enterprise in making or improving private canals. Do you think it would be a stimulus?—I would not recommend that for a moment.

53. *Q.* (*Mr. Higham.*)—There is a small reduction I see?—Yes, that is for clearance.

55. *Q.* (*Mr. Ibbetson.*)—I understand you to think that taking Sind as a whole two-thirds fallow is not an excessive estimate?—I think that would be about correct.

55. *Q.* Do you think that this large fallow area is due to want of labour?—Yes, I think so.

56. *Q.* As the population increases, you may expect to see that diminish?—Certainly.

57. *Q.* Mr. Palliser seems to think that a perennial supply would not reduce the fallow irrigation?—I do not agree.

58. *Q.* You say wells are very valuable to supplement the canal irrigation in the *rabi*?—Yes, in certain areas.

59. *Q.* I understand that well-irrigation is charged at the rates which they would pay for the available canal-irrigation if they took it?—Generally so; if the land would ordinarily be irrigated by lift, then the *kharif* lift rate (the lowest rate of assessment) would be taken, and if by flow, then the flow rate.

60. *Q.* Is not that assessing private improvement?—If we were to assess it according to the lift *rabi* rate, we should put on a couple of rupees at least. If you look at our table of rates, you will see that this is the case.

61. *Q.* Practically then the well does get lower rates?—Certainly.

62. *Q.* I see from statement E that in 1896-97 there were 4,000 wells; in 1897-98, 2,000; and in 1898-99, 5,000. What does that mean?—The number of wells depends on the goodness or otherwise of the inundation.

63. *Q.* Does it mean the number of wells actually worked?—Yes.

64. *Q.* At any rate we have the fact that you have never reached a maximum of 6,000 wells in Sind?—No. This statement E is a statement of cultivation by wells only; you ought to add the number of wells aided by canals—8,328. Take 1899-1900, 5,617 wells; in addition to that in that year there were 8,328 aided by canals, altogether that is 14,000.

65. *Q.* In the areas in which wells can be constructed moderately and can be worked at a profit is there much room for extension?—Yes.

66. *Q.* What could we do to stimulate that extension?—If you could do away with all the present complicated rules regarding *takavi* and allow us to give *takavi* on simple rules.

67. *Q.* What are the main points you would suggest?—I must refer to the present rules. When the Mukhtiarkar has drawn a cheque it has to come back to the Huzur Deputy Collector for an endorsement of an order of payment. I should like to see one document which should form the application and the bond. That document should be given to the zamindar who should present it to the Mukhtiarkar for endorsement as to the amount of land to be held in security. I don't think it is necessary to go thoroughly into whether the *takavi* is much needed or not. Some certificate is necessary. That being satisfactory the applicant takes his money.

68. *Q.* How long do you postpone the first recovery?—It depends. There are two systems of *takavi* grants under two different Acts. Under the Land Improvement Act, the postponement is ordinarily fixed with reference to the time when it is estimated that the improvement will begin to yield a return. Under the Agriculturists' Loans Act, the postponement of the first payment is usually for 12 months.

69. *Q.* What is ordinarily the period of recovery?—Up to 20 years in grants made under the Land Improvement Act.

70. *Q.* Is that ordinarily given?—No.

71. *Q.* Why?—I don't think the Revenue officers are always as lenient as possible, and in Sind few (if any) large works rendering long period advisable are carried out by private individuals.

72. *Q.* What is the ordinary period allowed for the repayment of, say, 300 rupees?—From five to six years.

73. *Q.* Would not lengthening that period promote applications for *takavi*?—I don't think so. With regard to *takavi*, I am anxious to make another improvement. We used to give money for canal clearance under the Agriculturists' Loans Act as being an ordinary recurring expenditure, but Government now insists on its being granted under the Land Improvement Act.

74. *Q.* Is the latter system more complicated?—Yes, money for ordinary clearance operations should not be treated as public works. Most of our money under the Land Improvement Act is given for canal clearance and very little for wells. I think it would be a very great advantage if we could go back and grant the former under the simpler system.

75. *Q.* Do you think having to pay 6¼ per cent. makes much difference?—No.

76. *Q.* What security do you take?—Land, chiefly.

77. *Q.* The land to be irrigated by the well?—I was not thinking of the wells—the man's holding.

78. *Q.* Do you require collateral security?—Not generally.

79. *Q.* Do you insist upon registration?—That is according to the amount.

80. *Q.* Has a man to go to a registering officer to register the security?—No.

81. *Q.* Do you lend on the joint security of a village?—No, there is no village system.

82. *Q.* Supposing several landowners came and wanted to borrow on their joint security, would you lend them?—Yes, I have got all the people to sign together, but of course it has given an immense amount of trouble; but by the

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means I have got a canal cleared which they would not have done independently.

83. *Q.* There is no combination among them?—No.

84. *Q.* Has a landowner any difficulty in sinking a well? Is he likely to come across difficult strata?—Yes.

85. *Q.* Should not help be given—boring tools, expert assistance or advice?—I don't think so. They have their own skilled men for wells.

86. *Q.* (*Mr. Rajaratna Mdlr.*)—Are remissions only granted in years of drought?—Remissions are granted when the crop fails for any cause for which the cultivator is not responsible.

87. *Q.* Every year it is granted? It is to be expected every year?—No. It is not expected; out of a whole taluka you will not get a single application.

88. *Q.* Do you grant remission for a 2-anna or a 4-anna crop?—If the value of the crop is less than double the assessment, remission is given.

89. *Q.* You have no sort of classification?—No.

90. *Q.* The value is double the assessment?—Yes. Then Government takes one share and the zamindar takes the other two shares.

91. *Q.* Is the remission limited to a tract or to individual fields?—The individual field.

92. *Q.* Even though the surrounding fields may have less?—Yes. They would then be entitled to remission also. It used not to be so. The remission rules are absolutely the result of long experience.

93. *Q.* In statement E mention is made of "wells independent of canals"?—They are said to be so; I say they are not.

94. *Q.* I suppose all these well-lands are commanded by the canal; they might get a canal supply?—I should say a very large number could.

95. *Q.* If canal water is used for one month and well water for the remaining period, do you charge?—We charge the ordinary rate. We generally charge the lift *kharif* rate.

96. *Q.* What would be charged if a field got assistance from a supply which belonged to Government?—We should charge according to the description of supply received, *i.e.*, no more unless such supply was superior, as, for instance, *rabi* lift from a canal.

97. *Q.* Are these well-lands assessed independent of the canal?—In those cases where they are independent of the canal we still examine to see what the canal supply might be.

98. *Q.* Have you any information as to the number of wells constructed during the last ten years with the aid of loans?—No. There have been very few. The people making wells don't care for loans. They are generally careful men and I don't think they care to borrow.

99. *Q.* You said if the procedure as regards *takavi* advances was simplified and loans promptly granted, there would be more applications?—Yes. I am trying to simplify the procedure and have called for reports from all Collectors. Before the applicants get the money into their hands there is great delay.

100. *Q.* Why don't people take the loans?—In the matter of *takavi* we are going along at a tremendous rate, as Return I (Revenue Statistics) will show, but the uncertainty as to grants forms a hindrance. Thus, in the financial year 1897-98, Government was unable to give any grant to Sind.

101. *Q.* Would the appointment of a special officer for disbursing loans promote extension?—That is a question like many others that I have been thinking about. I think it might, but the worst of it is that he would be wanted everywhere, and often all that is necessary is a very little inquiry. One proposal has been put forward, which affects *takavi, i.e.*, on certain fixed days, the Mukhtiarkar should be in the *kachari* for the disposal of all personal applications or complaints, the fact being widely known. The *takavi* would then be given without any references to subordinates. The proposal is already known as *kachari* days, and there is no doubt that it would be an advantageous one. Sending a cheque to the Huzur Deputy Collector is simply ludicrous; it doesn't make things one atom safer.

102. *Q.* (*Mr. Higham.*)—Turning again to this question of fallows. I understand that when an estimate for a canal is made, it is customary to take ⅓ of the area that will be brought under command as the area to be irrigated annually?—I think that is generally done. I should say that was the rule. I don't think though there is a rigid rule to that effect.

103. *Q.* Looking at the figures you have given to us, it appears there are about 7½ millions acres on the canals and 2½ millions irrigated only. Is it considered necessary that there should be a fallow two years out of three to save the land from exhaustion?—That depends upon the water-supply and the owners of land you are dealing with.

104. *Q.* If you have very good land and plenty of water, there is no reason why you should not irrigate the same land every year?—Yes. There are large areas in Sind cultivated annually. Ordinarily rice is cultivated every year.

105. *Q.* In some parts they give rice land a fallow?—Yes.

106. *Q.* Is there room for increasing the irrigation in Sind, not by going into new tracts, but by carrying out improvements on the existing canals?—Yes, to a very considerable extent.

107. *Q.* The ⅓ rule would not apply?—You would not get an exactly proportionate return by remodelling—say you doubled the area of supply. I don't think you would double the cultivation.

108. *Q.* My point is this. To increase the total area in Sind, it is not necessary to take up new lands or new territory?—No, there is a good deal to be done on existing canals; the remodelling, apart from extensions, will lead to larger irrigation of the area commanded.

109. *Q.* One of our witnesses said the people were very right in some cases to abandon lift irrigation if they got flow lower down. Have you known any cases of that sort?—I can give you an instance of abandoning lift for flow in the lands adjoining the Jamrao, *e.g.*, the Tando Allahyar Taluka, the cultivation of which is all under lift and the cultivators of which have been with difficulty kept from transferring their tenancy to the zamindars on the Jamrao.

110. *Q.* The difference between the rates of lift and flow appears to be very slight?—Yes, I am not surprised at your saying that.

111. *Q.* What is the difference?—Here is a taluka with a lift rate of Rs. 2-12 and flow Rs. 3-8. In Sukkur, which is a very good taluka, the rates are—flow Rs. 4-4, lift Rs. 3-8. Rice is more of course. The difference varies. If we had the population, the lift would be the best, because it does not render the soil water-logged, has better straw for cattle, and the people live in a happier way in their villages in the talukas where there is lift irrigation. Every Revenue officer will say that lift is better.

112. *Q.* Have you any idea what the cost of lift may be taken at?—The subject of the cost of lift has been dealt with at great length by different officers and is one regarding which I could submit statistics, but not give any definite figures off-hand.

113. *Q.* I want to know whether you can explain on what considerations the lift rates depend?—The lift is a very sure supply. It never fails and never varies. They don't have troubles as regards flooding.

114. *Q.* You don't think it would be an advantage, as far as the people are concerned, to convert lift irrigation into flow. You think they are better off as they are?—Yes, I think so, but crops are raised with so much less trouble and labour under flow that limitation to lift would mean a great reduction in the food supply. Moreover, it is only following an economic law that people should go where they can raise the largest area of crop with the least labour, *e.g.*, when the ground only needs to be scratched and the water to be turned on.

115. *Q.* When the Rohri Canal was thrown out by the Irrigation Committee of 1892, were you on that?—No.

116. *Q.* One of the arguments in favour of the project was that it would give flow irrigation?—Yes.

117. *Q.* I think all the new project substituted for it will not give flow?—It is rather a difficult thing to say, for they are supposed to give a very considerable flow supply. I am very much inclined to doubt if they will give as much as is anticipated. I know lift areas where people cannot be got to take up the land, *e.g.*, the Tando Allahyar Taluka.

118. *Q.* Anything to do with the rates?—Nothing at all. It would not be wise to say one prefers lift to flow. Either is very good for the production of grain in the country.

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119. *Q.* If a weir were made at Sukkur, it would re-open the question of the Rohri Canal?—Certainly. If the weir was possible, about which I know nothing, it would be magnificent in its results. In the first place, the whole of the Khairpur State could be irrigated, then you come down to the Hyderabad district with its high lift lands which would all be irrigated by flow. The Dad and the Nasrat Canals would be abandoned of course as independent canals.

120. *Q.* The statements we have had regarding the weir deal mostly with the right bank. As regards the effect on the left bank, we have not had any opinions?—You can get the whole matter from Mr. Joyner's report.

121. *Q.* Is colonisation now proceeding on the Jamrao?—I am just going out to see about it. None is proceeding at this moment.

122. *Q.* Why?—Because there have been difficulties about the supply, and the Colonisation Officer, Mr. Robertson, wrote in and said he thought we had better not go on with the colonisation until the success of the canal was more sure, because if these colonists saw any deficiency they are apt to pack their goods and go home. The first 8 miles has silted a good deal, but it goes through a very bad bit of sandy country. But that, in the opinion of the Engineers, was to be expected and will gradually right itself. Then where we can we will begin colonisation again.

123. *Q.* You are now marking time?—Yes.

124. *Q.* How many colonists have you?—26 yeomen, 116 peasants.

125. *Q.* The irrigation that has been recorded has been mostly by the existing people?—Yes. To the local people we have given large areas of land.

126. *Q.* The colonists all came from the Punjab?—Yes.

127. *Q.* Has the question of rates on *jagir* lands ever been discussed?—The question of *hakabo* has been discussed as to what the rate should be, and it has been definitely fixed for Kelat at Rs. 1-8 per acre.

128. *Q.* Is there any other case except that of Kelat?—Yes, on *jagir* lands in Sind irrigated by Government canals the rate on which varies from 10 annas to 5 annas per acre according as the cultivation is 'rice,' 'flow' or 'lift.'

129. *Q.* One rupee is what a zamindar generally takes as *hakabo* when he clears a canal.

130. *Q.* And he takes a share besides?—No, he takes nothing more for cost of clearance.

131. *Q.* There are some private channels on the Fuleli?—Yes.

132. *Q.* If Government made the distributary channels, water would be economised?—Yes, but it should be remembered that the canals had for the most part existed prior to Government taking possession of them, and that they had a vast net-work of private channels, *i.e.*, distributaries from them which it would take an immense sum to remake or remodel, and merely to build the sluices on their mouths means lakhs of rupees.

133. *Q.* In many places the water-courses run parallel to each other, so that each man may have his own channel; that leads to waste of water?—Yes, but the people object to being shareholders and insist on their right to separate channels. But in the Hyderabad district, where the old Inundation Canals are very bad and the clearances are heavy, the people would gladly have their channels cleared by Government. A very curious thing which I may mention as regards the irrigation in Sind is, that under the Irrigation Act the sluices are the property of Government which the people used to be made to make. Even now we try to get them to pay part, usually half of the cost. Properly speaking, the onus is on Government. The policy, however, is to leave things to work on as they best can on all existing canals.

134. *Q.* What do the sluices cost?—Anything from 200 to 1,000 rupees. If you put all these sluices in direct charge of the irrigation subordinates, it would mean an enormous increase of establishment. It seems better to watch the new system on the Jamrao and see how it works and then on that experience improve. When canals are remodelled all the sluices are provided by Government.

135. *Q.* From what I have heard the colonists are not very satisfied. Why are they only brought from the Punjab?—That is the effect of the Chenab. Our colonist officer went to the Chenab and studied the work there and so sought his colonists from the Punjab.

Mr. F. S. P. Lely.

The Honourable Mr. F. S. P. Lely, C.S.I., I.C.S., Commissioner, Northern Division.

(*Ahmadabad, 5th December 1901.*)

Note by witness.

Natural silting up of the drainage of the province.

The province of Gujerat has for the most part been formed by alluvion—a process which is still going on. An arm of the sea which once separated it from Kathiawar and is now represented by the Ran of Cutch and the chain of lagoons known as the "nal" has been filled up within comparatively recent times. The effect has been to silt up the lower courses of the rivers of that region so completely that instead of reaching the sea they spread out over the country forming water-logged tracts with the usual accompaniment of saline efflorescence. Such has been the fate of the Banas which once emptied itself into the Ran of Cutch, of the Utavli, the Nilki, the Bhadar, the Rodh river in Sanand Taluka and others of small size. The same process is, if I am not mistaken, going on all down the coast of Gujerat as far as the Tapti clogging the drainage of the country. The whole Gulf of Cambay is being filled up with shoals, leaving only a narrow and devious water-way, as may be seen on any chart. The Matar Taluka, once thoroughly drained by the Watrak and the Sabarmati, is now so obviously deteriorating that Government have had to make one reduction in the assessment and will soon have to make another. The town of Cambay, once upon the bank of the Mahi, is now removed from it by several miles of alluvial bank. There are water-logged areas in Broach districts north and south of the Nerbudda and in the Olpad Taluka of Surat. At the same time the popular voice is unanimous that in the rivers that command these areas the volume of water is much less and the beds higher than they were within the memory of living men.

2. If the above impression is correct, it seems likely that the successive rivers from north to south, beginning with the Bhogawa and Sabarmati, will silt themselves up and stagnate over the country, or find themselves other courses. In my opinion the subject should be thoroughly examined and reported on by an expert Engineer, so that broadly-conceived measures may be taken to prevent the deterioration that has begun.

Canals.

3. *Irrigation by Canal.*—This is not everywhere possible, and where possible it is not always suitable. In the southern half of Surat district it is not needed, because, with a heavy and generally constant rainfall and a retentive soil, a second crop (leguminous) is grown after rice without any artificial watering. North of the Tapti the soil becomes black and is devoted to cotton, which is not picked until the cold weather is over. It is said that watering makes it run to wood and leaves, but however that may be, the extra cost would not be recouped at present prices. Nor is there anything to take its place. The people would certainly not take canal water in the black soil country between the Tapti and Mahi rivers, or in the west of the Ahmadabad district. It would also be superfluous in land so retentive of moisture. In the sandy soil of Parantij Taluka, again, the Hathmati Canal has been a failure, because among other reasons the loss in the channel by percolation is enormous and because the rice beds will not hold water without great wastage.

4. The only tracts where canal supply would be welcomed by the people are adapted for rice fields, the sand being mixed more less with loam. In many villages on the Khari system the soil is so light that it would almost never support a rice crop to the end without the artificial supply. Even in other more retentive soils the latter rain fails in two or three years out of five; but if water could be guaranteed through the cold weather, a second crop of barley or wheat could be secured (provided there was manure), whether the rice needed watering or not. The value of a canal reaches its climax in those villages where the wells are salt.

5. Although canal irrigation is not, as a rule, suited to Gujerat, I should not oppose certain well-considered schemes. Objections are: (1) the great difficulty of securing a supply which may be depended on in years of scanty rainfall, *i.e.*, in the years when it is most wanted; (2) the danger that projects may be adopted as were those of the Hathmati and the Tapti canals on engineering rather than on agricultural considerations; (3) the temptation to the cultivators when water is brought to them without effort to overcrop their land and to overflood it. On all these points and on others, wells have the advantage. On the other hand, there are tracts where, though the land is good and the cultivators intelligent, many of the wells are brackish. In those tracts a canal scheme might be considered if otherwise feasible, if a supply can be assured and if the soil is suited to rice cultivation which is and will long be the chief crop in Gujerat to need irrigation.

Irrigation tanks.

6. It is for the rice crop alone that the *system of irrigation tanks* in Gujerat came into existence. They have come down from Native rule. Their necessity is based on the fact that in probably 3 years out of 5 the yearly rainfall suffices for sowing, transplanting and bringing the plants forward, but fails at the last when water is needed to mature them. They are sometimes nothing but basins in the corners of fields which conserve the early rain, to be paid out some weeks later. They then run dry, whether large or small, for they are not dug deep. Their bed should be higher than the surrounding country to allow the water to run on to the fields by gravitation. It follows as of course that they are of no use for watering *rabi* crops, though they are often the means of saving a most valuable outturn of rice. It may be mentioned here that the "kamod" rice grown in Northern Gujerat commands the top price in the market, being the only sort the wealthy classes will eat. Successive good crops would probably pay the cultivator better than sugarcane.

7. The particulars of these irrigation tanks will be before the Commission, as also the declarations of the highest authorities that Government is bound in honesty to keep them in repair in return for the special water-rate which forms part of the assessment. They have not been repaired, as they should be, for reasons the Public Works Department will explain. I have only to suggest that the preference given to people who contribute 10 per cent. of the cost should be abrogated. This would leave the Public Works Department entirely free to take up systematically groups of tanks year by year, which would tend to economy and thoroughness.

8. It has not been the practice to give remissions of land revenue when these works fail. They should be given with reference to the general area-estimate of crops, but not with reference to the water as distinguished from the soil. For if the crop fails, the whole fails and a remission of the water-rate only, retaining the soil rate, will not meet the case. The division between the two heads is made in the survey records, but differently in every district, and there would be room for difference of opinion as to the correctness of the adjustment. I am myself of opinion that, as a rule, enough is not credited to water.

9. The repair and construction of such works, if not undertaken by a private landholder, concern the Imperial land revenue only, and are altogether outside the sphere of District Boards. When expenditure is incurred by the Public Works Department on an irrigation tank which is also a village tank used by the people for drinking, bathing, or watering cattle, etc., it is the practice in this division to get a contribution from the District Board. If private landholders wished to undertake work of this kind on their own land, they could readily obtain *takavi* for it, but they never do.

Village tanks.

10. I do not agree that a good deep *village tank* such as was dug in large numbers in recent famine time is useless even although not used at all for direct irrigation. In olden times it was one of the first benefactions that occurred to the man of means who wished to spend his money for the public good. A sheet of fresh water which holds out through the year is a centre of health and sweetness. It humidifies the atmosphere. It is a means of cleanliness to man and beast. Above all, it permeates to all the wells within its influence and corrects their brackishness if it exists. Remarkable instances of this could be adduced. On the whole, I am of opinion that in arid, saltish tracts there is no more beneficial form of famine labour possible than sinking a well-planned tank for storing rain water.

Impounding river water.

11. Similar to these are *water pounds in rivers* where owing to rocky beds they can be made without great expense. In the river Wanki, south of Bulsar (Surat district), the B., B. and C. I. Railway Company made some years ago a masonry *bund* with a sluice in order to provide a supply for their station near at hand. The result is a permanent store of water which is a delight to the eye. By saturating the adjacent country and also by means of *dekudis* it has changed a limited area into a perennial garden. Many such *bunds* and sluices would be possible in the small rocky rivers of that part of Surat district, and also, I should think, in the upper courses of the Mahi and other rivers. They would probably not be remunerative to Government at first for several reasons, but they ought not to cost much on well selected sites, and they would conserve in the most beneficial form masses of water which now run off useless. The people would slowly learn to take full advantage of them.

Steam pumps on rivers.

12. A modern form of enterprize is the erection of *irrigational steam pumps* on river banks. I know of four on the Sabarmati and one on the Watrak, and there may be others. The water is generally supplied to the cultivators in return for a half share of net crop. These undertakings should be encouraged by Government by imposing reasonable and uniform conditions, and the possibility of their great extension should be borne in mind when framing such schemes as the Sabarmati Canal.

Wells.

13. First, however, in the list of irrigational methods in Gujerat must be placed *wells constructed by the people themselves*. The fact that a cultivator is willing to take the risk and trouble of making the well and of drawing the water is a security that he has the means to make it a success,—the knowledge, the energy, the appliances and the manure! The canal and the gravitation tank made by Government guarantee none of these things. In restricting both the number of wells and the amount of water daily supplied to the land the co-operation of the cultivators acts as an automatic check on over-irrigation which does not exist when water is brought without consulting them and laid on their fields without any effort on their part. Consequently when subsoil water is sweet, plentiful and at a workable distance from the surface, nothing more is advisable than to encourage the cultivators by easy grants of *takavi* to dig wells. Unfortunately these conditions are often absent.

Takavi—Interest.

14. I think the interest on works of improvement as distinct from mere "agricultural loans" should be reduced to 3 per cent., *i.e.*, 4 annas per month. Whatever may be the case in some other parts of India, it is certain that in most of Gujerat in ordinary times the *sowcar* will lend for a sound improvement, such as a well, at 8 annas per month, *i.e.*, 6 per cent. per annum *plus* a small commission on "opening his bag." On loans for seed, buying cattle, subsistence of the cultivator, etc., he will of course demand more, and there is not the slighest reason why Government should not do so also and keep to their present rate.

Takavi—Promptitude in distribution.

15. I do not think the method of distributing *takavi* for permanent irrigational works needs any further simplification. Small loans for *kachcha* wells and for seed, etc., do not come within the scope of this discussion and should not, in my opinion, be given at all by Government except (1) in time of famine, or (2) to backward races whom it is desired to free from serfdom to the *sowcar*. It may be well that the officer distributing for these purposes should be able to carry money with him on tour and pay it out without any circumlocution. But in this division the practice for larger loans is for the applicant to present himself once before the Mamlatdar to ask for the money and again after the report by the "Village Panchayat" to receive it. These visits to the taluka head-quarters are not regarded by the people as in any sense a hardship and are of positive advantage as marking the gravity of the transaction. A man who really means to make a well will give himself much more trouble than that to interview the brick-maker or the mason, or, when need be, the *sowcar*.

Takavi—Strictness of recovery.

16. Herein lies the crux of the *takavi* system. The cautious landholder is unwilling to make himself liable to yearly payments which he knows will be enforced with regularity, even, for all he knows, to the forfeiture of his lands. It is not merely the chance of a bad year for he may hope for lenience on account of that. If a death or marriage takes

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place in his house and sweeps off all his ready money, the *sowcar* will make allowance, but not so Government. Hence he hesitates. On more than one occasion I have lately been told by villagers that before taking large sums to build wells they intend waiting to see how it fares with those who borrowed from Government during the famine. The difficulty is not an easy one to meet, for of course a loan for a remunerative work must be recovered on business-like terms, and any attempt through the village officers to take account, as a *sowcar* does, of a man's private circumstances would only result in unbridled corruption. A general concession, I would suggest, is the recovery by easier instalments than have hitherto been usual. The life of a well being from 50 to 100 years or more, there is no reason why repayment should not be spread over 20 years or more. This would not be felt by a vigorous man. The smallness and the definiteness of the demands combined with freedom from dunning between-times would be realized by all as great advantages.

Takavi—Risk of total loss.

17. The worst contingency of all is that the well, being dug, may turn out a failure. Only yesterday I met a man in Sahijpur (Dholka Taluka) who by all accounts spent and lost Rs. 500 in this way last year. He had called in a Brahmin "Joshi" of local repute who professed to find water with wand and incantations, but only succeeded in finding salt water. This morning I saw a well (in the Kaira district) which had first of all been dug and steined to the depth of 20 cubits, giving sweet water. The supply ran short and digging was continued with the usual wooden ring, 10 cubits at a time, until a plentiful spring was reached at about 50 cubits from surface of ground. This was good to the taste, but after a year's trial turned out to be "chopdu," that is, its effect was to bind the soil together like glue and eventually stop all growth. The result is that the well on which nearly Rs. 1,000 has been spent lies unused and useless. The unfortunate owner told me with tears in his eyes that he had borrowed all the money in 1954 (A.D. 1897-98) from a *sowcar* at 6 per cent. and had nothing to show for his enterprize but the debt. Many wells, especially in favoured tracts, give a sweet and full supply at 20 or 40 feet from surface. Some give none at all within a reasonable depth. Some are salt from the beginning. Some are sufficiently sweet for one watering but not for more, and these are of some use for rice cultivation. Some are good for one season and then must lie unused for two or three. Some most disappointing of all are sweet for a year or two and then gradually turn salt.

18. The question is, can the people be assisted to meet these freaks of fortune? The use of boring tools (Shaeda) good down to 30 feet or so is known to the people in many parts, and two or three are being placed at Government expense this year in various talukas for free loan. I am not, however, sanguine of much result. Either they will not find favour for want of expert direction, or being roughly and carelessly used they will soon get broken. Private blacksmiths have already begun to supply them on daily hire, and in ordinary times it would seem better not to interfere in the business. The use of these shallow-boring tools will not, however, always or often prevent loss, for permanent sweet-water is not often struck within 30 feet, and in most soils the steining has to be put in before that depth is reached. I notice below the suggestion that deeper boring under trained men should be carried on in tracts where the upper water-bearing strata are salt, and it might be arranged that these parties may bore in the land of any holder who is willing to pay the whole or, say, the half of their expenses, or, better still, a fixed fee. Cases in which the water is not salt but "chopdu" are much more rare. At present the cultivator has to wait for a round of seasons before he can detect the fault. The Agricultural Department should have at its service a laboratory where all such points can be settled at once for a small fee. Few of the people would resort to it at first, for they would have little trust in its verdict. The sooner a beginning is made the sooner such agencies will justify themselves. With the spread of education leaflets to inform the cultivator what is being done and what is possible to him would be useful Ultimately he would only have to get a boring made, deep or shallow, as may be indicated by the general water level of the country and get a sample tested both for merits and defects, though even then he would have to take the risk of the water subsequently turning salt.

Takavi—Remission in case of failure.

19. It has been suggested that remission of *takavi* should be given in every case of failure. There is much to be said for this proposal, but also many objections. It would lead to many and varied attempts at fraud which could only be guarded against by thorough inquiries which the already overburdened staff have little time to make. The Collector might be given power to make remissions in hard cases, but this half and half solution would also be objectionable. A definite promise on which a claim can be based is necessary to produce full effect and also to exclude favouritism and intrigue. On the whole, I do not see how Government can safely take upon their shoulders the risk of failure and am not very sure it would be desirable to do so if they could. I would prefer to minimize the risk by expedients noted above and below—paragraphs 18 and 21.

Construction of wells by Government agency.

20. It has been suggested that Government should go still farther than this and undertake the construction of wells on a wholesale scale. I am entirely opposed to this. It would be a serious advance on a wrong line—the line of doing for the people what they can do for themselves. If we build their wells, we may as well build their houses. An experienced cultivator can judge better than any Government agency whether it will pay or not to make a well in a particular field. If he undertakes the risk and trouble, it is the best guarantee we can get that the position is suitable, *i.e.*, near the village, that the soil is suitable, that manure is available, that water is likely to be struck. He is much more likely to be right on these points than a Government officer whose only interest in the matter is to show a return of work executed. Granting, however, for the moment that the latter is as good a judge as the former, the next question will be, who is to pay for the work? If Government is to pay, every one will want the free gift and have an equal right to it, and very few will be able to get it. Those would have to be excluded whose subsoil water was indifferent or who could not use a well for want of manure or would not for laziness (there are many such). In the weeding out of such holders bribery would be rampant; but even if they were fairly eliminated, it cannot be seriously contended that the remaining lucky ones should be supplied with a well at the expense of the State. Yet the cost could not be charged on them either in lump or by enhancement of the assessment at the expiry of the guaranteed term without their consent, and no man in his senses would give his consent to have his work done by the Public Works Department. Not only would it be twice as expensive as if done by himself, but no man would willingly bring about his place a gang of subordinate officials with their impertinent swagger and hard-and-fast rules when he could get the work done by his own people whose interest it would be to conciliate him and meet his wishes. The number of wells already in the country that lie unused is remarkable, either because of the badness of the water or because of the laziness of the owner or his want of means in the shape of tackle, bullocks, manure, dependents to help, watchmen to protect the valuable crop. The result of a system of Government well-digging would probably be to greatly increase these unfruitful assets. "Three acres and a cow" may be the ideal of rustic prosperity in England, but "three acres and a well" is by no means its equivalent in India, though popular writers often argue as if it was.

Deep boring.

21. There are tracts where the surface water is sweet and scanty, but where the people will on no account go deeper from a well-grounded fear of striking on brackish springs. In others there is not even an upper supply of sweet water. As things at present stand, unless there is an adjacent river, there is nothing possible in such tracts except perhaps a canal like that proposed from the Sabarmati. There are, however, indications which give some hope that in places deeper water still free from salt, with a head upon it, may be struck by deep boring which should be systematically undertaken. In Broach town there is a well in which from a depth of more than 100 feet the water rises of itself to above the river level. In Viramgam town, if my local informants are correct, a pipe was driven down below the brackish water, and after it had tapped a lower and sweet spring was broken, but a jet of sweet water still wells up 2 or 3 feet above the top end of the pipe. It was in this line of country that Mr. Griesbach recommended trial borings for an artesian well. Deep boring parties for special areas should be organized, each under a supervisor who should be a skilled mechanic. They should operate wherever the general results are likely to be most instructive, but they should be free to bore in a private holder's land on terms as suggested above.

Manure.

22. It is not irrelevant to mention that in this province at all events the beneficial results of irrigation depend directly on supply of manure. In the best villages that is the real check on the increase of wells, for no shrewd cultivator will spend money upon water unless he can make sure of keep-

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ing up the fertility of his land. It is surprising how little has been done to lead the cultivator to exercise economy and resource in this matter. The need has become greater than ever here since the famine reduced the cattle by 70 per cent. Mr. P. K. Subbiah's note on "Different systems of housing cattle and conserving manure" published as an "Agricultural Ledger" is being translated into Gujerati and, if approved by Government, should be circulated to every village. There are few now which do not contain some cultivators who can read and write, and much good might be done by the dissemination of useful agricultural information in vernacular leaflets. That, however, is wandering beyond the scope of this note.

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1. *Q.* (*The President.*)—How long have you been Commissioner of the Northern Division?—About 5 years.

2. *Q.* Were you here all through the famine?—Yes.

3. *Q.* You have submitted a very interesting memorandum. The opening paragraph as regards the silting up of the mouths of these rivers reveals a very serious matter and one that should be investigated?—Yes, it is a very serious matter indeed.

4. *Q.* You say in paragraph 3: "In the sandy soil of Parantij Taluka the Hathmati Canal has been a failure, because, among other reasons, the loss in the channel by percolation is enormous and because the rice beds will not hold water without great wastage"?—Yes, the country is not suited to rice cultivation.

5. *Q.* Is it not worth while using the water for wheat and barley?—Undoubtedly; it is used, when they can get water in the cold weather.

6. *Q.* I gather from the note sent in by Mr. Beale that measures have been taken to prevent the loss from the canal; assuming that this is effective, would the canal then be a success, if the water did its full measure of work?—I should not like to speak definitely. My impression is that the result has been already to deteriorate a good deal of the land by efflorescence and the general complaint of the villagers also is that the land is getting exhausted because their supply of manure is not sufficient; the water being brought to their doors tempts them to over-water and over-crop the fields.

7. *Q.* Is the efflorescence on the increase?—Yes.

8. *Q.* Did it not exist before the canals were started?—I cannot say; it probably did.

9. *Q.* You say in paragraph 4: "The only tracts where a canal supply would be welcomed by the people are adapted for rice fields, the land being mixed more or less with loam." Is there any part in Gujerat answering to these conditions where it is likely that canal irrigation can be introduced?—That would be more or less the line the Sabarmati Canal is supposed to take; whether it is desirable or not is a question; it would lead to the people growing a second crop that would be chiefly regulated by the supply of manure; there is no doubt they would grow barley and wheat.

10. *Q.* You say the canals are broken reeds, for the water fails in time of need; would it be worth the cost to have a thorough survey made of the catchment basins to the north of this district, to see whether it was possible to store water?—Yes, especially in the Panch Mahals.

11. *Q.* The best plan would be to have the catchment basins exhaustively examined?—Yes, certainly.

12. *Q.* We were assured that brackish water was very good for barley?—Yes, if it is not too brackish; and it is not bad for wheat.

13. *Q.* Mr. Mollison says it is to be recommended for tobacco?—Yes, particular salts.

14. *Q.* You say in paragraph 7: "I have only to suggest that preference given to people who contribute 10 per cent. of the cost should be abrogated. This would leave the Public Works Department entirely free to take up systematically groups of tanks year by year which will tend to economy and thoroughness." I thought that the Public Works Department, quite apart from this rule, takes up any tank needing repairs?—A certain amount of expenditure goes on, and as those who pay 10 per cent. have the preference, the others are more or less out of it.

15. *Q.* It seems to me a little hard that if villages are willing to contribute a share that that willingness should not be taken as an indication that their necessity is great and that preference should not be given to them?—That simply means that they are ready to pay more than is due from them rather than not get it at all.

16. *Q.* Do you think there is a moral obligation on the State to keep these tanks in order?—Yes.

17. *Q.* I believe that when the last Revenue Settlement was made they were in such bad order that the settlement was made low in consequence. If the cultivator found he could not irrigate from a tank and he asked for a remission, would it be given to him?—Yes, the landholder often abstains from asking for a remission, believing that if he gets it, it will mean surrendering his rights.

18. *Q.* We heard that there are 1,200 tanks in Ahmadabad?—Yes.

19. *Q.* Would it be possible to fix a certain limit for those that Government declines to repair and make a remission if no repairs are made?—That is already done.

20. *Q.* And the assessment remitted?—We remit the assessment if we are asked to.

21. *Q.* With reference to what you say about sluices and *bunds* in paragraph 11, this refers merely to using the broad channel of the river?—Yes.

22. *Q.* Can you quote a case?—Yes, Colonel Prescott, who was a very experienced officer here 30 or 40 years ago, strongly recommended that a great deal might be done on the river Sheri by making *bunds*, but that is a point that requires very careful examination; it is the common belief that the water is "chopdu" (creates a caky soil).

23. *Q.* We were told yesterday that *sowcars* decline to lend money for the construction of wells?—I don't at all believe that they won't lend money for wells in ordinary times.

24. *Q.* It was said that the *bania* would not lend a large sum?—He would lend money if he was sure it was being properly used; as a matter of fact, no rayat can dig a well without help from the *bania* unless he gets *takavi* from Government. If a *bania* is satisfied that the money is going to be properly spent, he will lend it.

25. *Q.* I gather that you do not think there is any material inconvenience caused by delays in granting advances?—No.

26. *Q.* We heard yesterday that there was sometimes five and six months' delay?—That would be exceptional, I think. It depends upon the personality of the officer concerned; there need be no great delay.

27. *Q.* Do you think it would be a popular measure and an expedient one instead of giving advances, merely, to give the money and assess wet rates in future?—I should think it would be accepted with reasonable arrangements, but a man would sooner have the well his own property.

28. *Q.* It would be his own property all the same?—As long as there is assessment, he thinks it is likely to be increased.

29. *Q.* You suggest the reduction of the rate of interest to 3 per cent.; would it stimulate the construction of wells largely if Government were to give it free of interest altogether?—Yes, I think it would.

30. *Q.* As a famine protective measure?—Yes, I should think so.

31. *Q.* If it was given out on these terms for the next ten years or something of that sort?—The Government made a similar concession on *takavi* advances during the time of famine and it was very much appreciated.

32. *Q.* The moral effect would be good?—Yes.

33. *Q.* You think that one cannot go wrong in multiplying good wells?—Not if the people have the construction in their own hands.

34. *Q.* You say in paragraph 16: "A general concession I would suggest is to recover by easier instalments than have hitherto been usual" and that "repayment should be spread over 20 years or more." I understand the law allows 20 years?—I don't think the practice is so.

35. *Q.* What is the practice?—It depends upon the idiosyncracy of the Collector; I think it ordinarily is not more than 10 to 12 years.

36. *Q.* You on the whole recommend that remission on *takavi* should be given in every case of the failure of a well?—No, it is a very doubtful point.

37. *Q.* Supposing a man came to the Collector and applied for assistance in boring and it was given; if that well turned out a failure, I suppose you would help the man then?—Yes.

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38. *Q.* On the whole, what measures on the part of Government do you think advisable to protect this province of Gujerat and to make it more fit to withstand famine?—I don't think anything heroic is possible; there are many useful minor measures; I should thoroughly prospect the Dohad Taluka of the Panch Mahals; then I would advocate the construction of *bunds* in rivers; of course the ancient system of tanks for assisting rice cultivation should be kept in perfect order; lastly, I should develop wells as freely as possible.

39. *Q.* Turning to the question of relief in famine, what is the best form of work?—Digging, certainly.

40. *Q.* Would you employ famine labour on small tanks?—Yes, because there is really nothing else.

41. *Q.* We have heard in some places of long earthen dykes placed across the country to intercept the water; would you recommend that sort of work?—They would only be possible in certain localities, *e.g.*, to intercept the flood water in the central and western parts of Ahmadabad. I don't think it would be possible on any large scale owing to the conformation of the country.

42. *Q.* We have had some evidence regarding the water-logging of certain districts and were told that in some places drains are looked upon with suspicion?—Undoubtedly a drain is a great boon in some years and a great curse in others.

43. *Q.* We have heard the objection to a drain that it flows too fast and washes off the good soil?—That is so.

44. *Q.* Do you consider these drains a good form of famine-relief work?—Certainly, most excellent.

45. *Q.* The famine work programme is got up, I understand, by the Executive Engineer in consultation with the Collectors; does it come officially before you?—Yes.

46. *Q.* Is it being kept up pretty well in these parts?—Yes, I have a complete programme.

47. *Q.* Is there any rule; observed as regards half-yearly or annual revision?—Yes, they are sent in annually to be revised.

48. *Q.* (*Mr. Higham.*)—We have heard a good deal about the drought in these parts, but does it ever happen that land is damaged by excessive floods?—Yes, before the great famine in 1899-1900 there was more damage by flood than by drought.

49. *Q.* That is to say, rivers overflowing their banks?—Yes, in 1875 the Sabarmati overflowed and did enormous damage, destroying valuable land. The country has not recovered from it yet.

50. *Q.* What was the effect of that flood?—It overlaid the good soil with sand.

51. *Q.* Does it draw up the salt?—No, it does not lie long enough for that; it runs over the country.

52. *Q.* The only damage is the sand?—Yes.

53. *Q.* If the country is thoroughly saturated by a flood of that sort, does it have any effect on the wells?—A great many wells got thrown out of use; they got silted up.

54. *Q.* They have not become saline?—No.

55. *Q.* Is there salt efflorescence?—Not that I am aware of; the flood comes and goes very quickly.

56. *Q.* In any proposal for putting weirs across the rivers these high floods would have to be considered?—Undoubtedly.

57. *Q.* In paragraph 5 you speak of the "danger that projects may be adopted, as were those of the Hathmati and the Tapti Canals, on engineering rather than agricultural considerations"?—Yes, I don't think from an agricultural point of view the Tapti Canal is a very promising scheme.

58. *Q.* Is it not now being reconsidered?—Not that I am aware of.

59. *Q.* I think the Bombay Government was asked to consider the question; you have heard nothing about it?—No.

60. *Q.* Am I to understand that on small or 'one man' tanks the water assessment has been taken off?—The Government does not take the initiative; if the people apply an inquiry is made, and if they do not get water we remit the assessment; if they get a water-supply the assessment remains, even if Government have no intention of keeping them in repair.

61. *Q.* In case it was necessary to employ relief labour, would it be suitably employed on small tanks?—It might but at most would not give very much labour.

62. *Q.* I mean village labour?—Yes, no doubt, many have been repaired.

63. *Q.* Are they entered in the programme?—Yes, the small ones are clubbed together in one item.

64. *Q.* You say in paragraph 6 that tanks are never in use for *rabi* irrigation, because they are very shallow and dry up at the time when water is wanted; if the tanks were deepened so as to hold more water, would the people lift water out for the *rabi* crops?—I am afraid not; some of the more energetic might.

65. *Q.* The cost would be more than they are willing to incur?—Yes.

66. *Q.* You say in paragraph 12 that steam pumps on rivers should be encouraged by Government by imposing reasonable and uniform conditions; is it necessary to impose any conditions at all?—It is a matter in which Government as general landlord may impose some conditions.

67. *Q.* Would Government have any *locus standi* in imposing conditions?—Yes, as proprietor of the water of the river.

68. *Q.* The Government is not the exclusive owner of the river; is it?—I should say so.

69. *Q.* As regards the Sabarmati Canal, you don't seem to be very strongly in favour of it?—No, I would only strongly advocate it in a year when we were very hard up when it might be worth trying.

70. *Q.* Do you not think it would have any protective value?—I doubt if the value would be commensurate with the cost.

71. *Q.* (*Mr. Ibbetson.*)—I gather that you don't agree with the opinion which has been expressed in the papers by some of the witnesses that famine is so rare in Gujerat that it is not worth while spending money to protect the Province?—No.

72. *Q.* When was the last great famine?—In 1813.

73. *Q.* How long have you been in Gujerat?—Thirty years.

74. *Q.* Within that 30 years has there been anything like severe distress or scarcity of any sort short of famine?—No, there has never been any need of relief works until the recent famine; there were a few works in the Panch Mahals in one year.

75. *Q.* Can you tell us anything of the period between 1813 and the time over which your experience extends; anything about the previous 60 years?—I should not like you to take my information as exact, but there have been years of scarcity.

76. *Q.* Was there no distress in 1877?—Yes, there was local distress, in the district of Broach especially; the crops failed locally owing to attacks of grass-hoppers; it was a terrible year in the Deccan but not in Gujerat, and there was local famine about 15 years before that.

77. *Q.* So that we have had three famines in the country owing to drought in which there has been no need for relief works in Gujerat?—Yes.

78. *Q.* Speaking of the Hathmati Canal, there seem to be two complaints—

(1) the rice beds will not hold water;

(2) the supply of manure is limited;

supposing it was possible to substitute *rabi* for rice, would not that meet both difficulties; *rabi* requires less water than rice?—I don't think that anything practical is possible. The cultivator would never be induced to believe in it. He would have no confidence in the supply of water holding out for the *rabi*. I think myself that it might be an advantage.

79. *Q.* In regard to the moral obligation of Government to clear the tanks, we were told yesterday that at the revision of settlement the state of repair, in which each tank was, was taken into account and the assessment was lowered in consequence, and we understood the argument to be that this removed the obligation of Government to clear the tanks; do you agree with that?—Yes, as regards land which received no water at the time of the revision of settlement.

80. *Q.* If Government now spends money on these tanks and restores them to their original condition, it might fairly take additional assessment on account of the improvement on the land already assessed?—If it gives a better supply.

81. *Q.* You have said that if 100 acres are under the tank the first land to suffer by the insufficient supply is the more distant land which loses its irrigation altogether, and that the assessment on this is reduced but not that on the nearer lands. The reduction is on the area irrigated, not on the quality of the supply?—Yes; the result of clearing the tanks would be to water the more distant lands which should be assessed again within the time of settlement.

82. *Q.* Have you had many applications for a reduction of assessment on the grounds that the tank is out of repair and the supply of water insufficient?—Applications of that kind don't come to me, but as Collector I remember they used to come in.

83. *Q.* Do you think that the number of such tanks bears a substantial proportion to the number of tanks which are filled?—A great number of people don't get water who have to pay for it; they believe that the tanks will be repaired sooner or later, and that by obtaining a reduction of assessment they would surrender their rights to the water. There is another reason, and that is, that the water-rate is included in the consolidated assessment, and they don't realize that they pay for the water.

84. *Q.* In the case of very small tanks, if Government has decided not to repair them and was prepared to remit the water-assessment, would it be possible to get the people to keep them?—It would be difficult to get them to combine.

85. *Q.* Seeing that Government is not prepared to do the work and that the people cannot, would Local Boards be a possible agency. Supposing Government were to allow Local Boards to take the wet assessment that may fairly be assessed on the land, and so put them in funds, could not anything be done?—I should not advise it; they are the worst agency you could have.

86. *Q.* You don't hope much from them, even supposing that the money difficulty is got over?—No. I should be inclined rather to trust to the agency of the people.

87. *Q.* Do you think the people might be induced to make small tanks?—They might, but there would be a difficulty in obtaining land for the tanks.

88. *Q.* You say in paragraph 8: "I am myself of opinion that, as a rule, enough is not credited to water." Do you know what the system of credit is?—It is a mere survey question; I don't think it is of much practical account; the assessments are consolidated; the separate assessment for water does not appear in village records.

89. *Q.* Is it not important that Government should know exactly what it gains by the tanks?—Yes, I think it is generally under-estimated.

90. *Q.* What is your opinion based upon?—I understand the general principle is that the heavier the rainfall of the country the higher the water-rate; in Konkan, I believe, the soil rate and water-rate are equal. Here, in Gujerat, where there is less rainfall, the water-rate is considerably less, as a rule, than the soil rate.

91. *Q.* You think it should bear a larger proportion?—Yes, the amount credited to the water should correspond more or less to the net produce of irrigated as compared with that of dry lands.

92. *Q.* Your opinion founded upon experience is that that is not the case?—Yes.

93. *Q.* Do you think the error is in the direction of crediting too little to water?—Yes.

94. *Q.* (*Mr. Muir-Mackenzie.*)—The scarcity or abundance of rainfall is not a legitimate ground for a higher rate?—Not, if it is fully replaced by artificial watering; it does not matter to a man whether he gets his water from a tank or the heavens. I would credit as much to the tanks in Ahmadabad as to the heavenly supply in the Konkan.

95. *Q.* (*Mr. Ibbetson.*)—Would you extend the number of tanks largely?—No, I don't think I should; in proposing a survey I had in view storage tanks. I would not increase the number of irrigation tanks.

96. *Q.* By irrigation tanks you only refer to one that holds enough water for rice?—Yes.

97. *Q.* Would you advocate large storage tanks?—Yes; where they are possible.

98. *Q.* Do you think they would pay—as a mere financial question?—They would not pay to begin with; not in the Panch Mahals certainly, as the people are not accustomed to irrigation; they would soon learn it; there is a great market for rice in the Panch Mahals.

99. *Q.* (*The President.*)—They might be carried on as famine relief works?—Yes.

100. *Q.* (*Mr. Ibbetson.*)—In Gujerat have they had any appreciable effect on the wells?—Yes.

101. *Q.* Such an effect as to materially increase their yield?—Yes.

102. *Q.* Supposing Government were to make a large tank in a tract in which there were wells, apart from the actual irrigation from the tank, would it exercise a material effect upon the prosperity of the tract through the wells?—Certainly; tanks sweeten the brackish water of the wells in Gujerat, and in this way do increase the prosperity of certain tracts.

103. *Q.* Would not the tanks be entitled to some credit in consideration of that improvement?—I am afraid that it would be difficult to estimate the amount; there would be so many shades of effect.

104. *Q.* It has never been done?—No.

105. As to wells, what estimate did you form of their protective value in the late famine; how did they work?—As a matter of fact, they were very disappointing; in the cold weather of the famine year they were immensely extended, but the crops were very poor, owing, the people said, to the ground not having been rained upon.

106. *Q.* Their protective value was not very great?—No.

107. *Q.* Does their supply decrease year by year in the case of prolonged drought?—Yes.

108 *Q.* Were they very disappointing this year?—The *rabi* crop promises rather well; but as the water-supply in the wells is much shorter, the area will be smaller.

109. *Q.* On the whole, they do afford a substantial amount of protection?—Yes, especially as regards fodder.

110. *Q.* Apart from the *takavi* question, have you any suggestions to make as to the means of stimulating the construction of wells by the people?—I don't know of any means except *takavi.*

111. *Q.* As regards the rule of exemption from assessment, I am anxious to get your views; it is of great importance to know how it works; we have been told that the people themselves have a certain amount of want of confidence in it; what is your experience; do you think that is so?—No, I should say not; I don't think the whole of the population thoroughly understands the intentions of Government, but they are gradually learning to understand.

112. *Q.* Would a cultivator, who had made a well and whose rate was enhanced on account of a rise in prices, realize that the enhancement was not due to the well?—Yes, I think so; his neighbour who had not made a well would also have his rate enhanced.

113. *Q.* Do you think that, as a rule, Government does arrive at the one object of exemption—the stimulation of private enterprise?—Yes.

114. *Q.* How long has this policy been at work?—It was legally established on the revision of the Code in 1886, I think.

115. *Q.* (*Mr. Muir-Mackenzie.*)—Was it not working before that?—It was then made plain in chapter and verse; I should be inclined to date it from 1886.

116. *Q.* (*Mr Ibbetson.*)—Do you think the people's knowledge of the principle might date from 1886?—Yes.

117. *Q.* Do you think the number of wells has increased much more rapidly since 1886 apart from famine years?—I cannot say one way or the other; in any case 15 years is a short time.

118. *Q.* Can you tell us any facts in support of your statement regarding the stimulation of private enterprise owing to exemption?—I cannot say. I have no statistics.

119. *Q.* As regards the effect on the ordinary rayat, do you think that he would make a well on promise of permanent exemption, when he would not make a well on promise of exemption for 30 or 40 years?—I think it would make a great deal of difference.

[Mr. Muir-Mackenzie read out figures relating to wells in Gujerat and stated that from 1886-87 to 1896-97 there had been a very small increase.]

120. *Q.* Now in regard to the question of recommending certain leniencies and liberalities in order to stimulate

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the construction of wells, such as the reduction of interest on loans and remission of advances, some of which you yourself suggest; the cost of these must of course come out of the public purse. In Northern India we can recommend them on the ground that, although for a time Government will lose money, still if extra wells are made after a period of exemption there will be a financial return in the shape of enhancement of direct revenue; in Bombay where the exemption is permanent there is no such prospect; whatever is given is lost for ever; and except as regards the general prosperity of the country there is no financial return?—No, there is a considerable return to the rayat, though not to Government.

121. *Q.* If you make the rayat a present of the interest on a loan of Rs. 1,000, you take it out of the pockets of the people of the rest of India. What I wish to point out is that in one case you get a return but not in the other, and that where the exemption is permanent it becomes more difficult to support the measures of leniency which you recommend. Take a province in which the term of exemption is limited, say, to 30 or 40 years; would you have the exemption permanent or would you grant the more favourable terms as regards interest and remissions; which concession do you think would have the greater effect in stimulating private enterprise?—Why not both?

122. *Q.* If you could get both, the question is in which way we should be more likely to stimulate private interprise in such a province; whether by the proposed measures of leniency or by changing the 30 or 40 years' exemption into a permanent exemption?—It would depend much on the view of the individual landholder. We might give him the choice between making his well with aid from Government liberally given with exemptions for a limited term, and making it without aid from Government with permanent exemption.

123. *Q.* Do you think a reduction from 5 to 3 per cent. interest on *takavi* would actually induce a rayat to make wells?—I think it would be a strong inducement.

124. *Q.* Would it induce him to make wells when he would not ordinarily make them?—Yes.

125. *Q.* Your well protects (not very effectually) 2 to 4 acres in one year of drought out of 30; is it worth the while of Government to purchase that amount of protection by remitting the interest on *takavi* loans for wells?—The protection in a famine year does not represent the total benefit by any means.

126. *Q.* You think it would be worth while on the whole?—Yes.

127. *Q.* You say in Gujerat a *bania* will lend money for wells at 6 per cent.?—Yes, to a good substantial rayat.

128. *Q.* (*Mr. Muir-Mackenzie.*)—Would he do it in any district?—It would be done in Surat. I don't doubt it would be done in Broach; I am speaking of pre-famine years; the security here is more valuable than in the Deccan.

129. *Q.* It is not restricted to the *patadars*?—It is restricted to a man of repute in the village.

130. *Q.* To large land-holders?—Not necessarily; it would depend upon the character of the man.

131. *Q.* Would a man holding not more than 10 acres have any chance?—If he is otherwise a man of trust, there would be no difficulty in his getting it; sometimes a *bania* goes shares in the well.

132. *Q.* (*Mr. Ibbetson.*)—You recommend recovery of loans by 20 instalments; it has been proposed in some quarters to allow 50?—I think that would be too much.

133. *Q.* Would not the risk of the well failing, or turning salt or falling in be a substantial danger to Government if it increased the number of annual instalments to 50; the longer the period of payment, the greater the risks? — I don't think it would be worth while to prolong the agony beyond 20 years.

134. *Q.* You lay considerable stress upon the rigidity of recovery; do your rules allow the postponement of instalments?—Yes.

135. *Q.* Are the rules acted upon?—Yes, it mainly depends upon the good word of the village accountant.

136. *Q.* Can you suggest any way in which this rigidity could be tempered?—Nothing, except by making the instalments so small that they would not be felt.

137. *Q.* We find complaints that the delay in granting *takavi* caused by inquiries as to solvency, etc., is one of the serious objections of our system; are such inquiries necessary seeing that by law the loan is the first charge upon the land?—Yes, I think they are; Government certainly have the right to supersede the *bania*, but I doubt it would be wise or just.

138. *Q.* You say that you hesitate to recommend a remission where the well falls in; supposing we only gave remissions where a well was constructed on a site approved by Government?—I don't think that would work.

139. *Q.* Supposing that we had approved of a site after a trial boring and that the well failed?—Then there would be good reasons for giving a remission, but I think that would be extremely rare.

140. *Q.* There is another suggestion that Government might only remit a portion of the advances?—I should object to that, as there would be a question of how much it should be.

141. *Q.* Does the absence of any tenancy right prevent tenants from making *bunds*, etc.?—The tenants don't lay out money on the land.

142. *Q.* Would not the old owners do it?—If they are protected they do sometimes.

143. *Q.* You don't think that the absence of protection operates so as to restrict extension?—No.

144. *Q.* (*Mr. Rajaratna Mdlr.*)—In reply to a question by Mr. Ibbetson, you said that there was in the case of most of the tanks a surrender of assessment at the revised settlement and consequently the moral obligation on the part of Government to keep up these tanks has been removed or lessened; so far as regards those lands which are still assessed as wet, is any reduction made in case the tank fails?—Upon application of the holder inquiry is made, and if the tank is found to have failed, the assessment is proportionately reduced.

145. *Q.* What amount has been spent on the repair of tanks during the past 15 or 20 years?—I cannot tell you.

146. *Q.* The number of wells in your division has not very largely increased?—No, I believe not.

147. *Q.* Might it be due to the present complicated system of inquiry regarding loans?—It might be due to some extent to the complexities of the system, unavoidably so, as we must be sure of some security. I don't see why there should be any undue delay at all; we are now beginning a new epoch in regard to *takavi* for which there was no demand before the famine; we ought to see a new development during the next few years; the system seems to be as simple as it can very well be made; a man asks for money, you make a reference to the village officers and if the inquiry is satisfactory he gets it.

148. *Q.* How long does it take?—It need not take a month; sometimes it is the man's own fault; people have a habit of going the last day and expecting the whole thing to be done in 24 hours.

149. *Q.* You said you are not in favour of granting remission of *takavi*; if special cases are inquired into by Divisional Officer, would you still refuse to grant a remission if he is satisfied that there has been no fraud and that the rayat honestly spent the money?—I have a horror of special cases myself.

150. *Q.* Do you think the Collector could make the inquiry?—The Collector is a very hard worked man; cases for special treatment would be very frequent once that was laid down.

151. *Q.* At the end of paragraph 13 you say "these conditions are often absent." You don't refer to any difficulties in *takavi*?—No.

152. *Q.* With reference to what you say in paragraph 15, is there at present anything to prevent an officer carrying the money and paying it on the spot?—It is not a desirable thing to carry large sums of money about on account of the fear of theft.

153. *Q.* Is there anything in the present rules to prevent an officer doing so?—No, except that there would be accounts difficulties. I don't say they cannot be overcome.

154. *Q.* Have there been many cases in which *takavi*, or a portion of it, has been remitted owing to failure of wells?—Not that I am aware of.

155. *Q.* You say in paragraph 20: "The number of wells already in the country that lie unused is remarkable"; are there any statistics to show the number of wells unused?—I am not aware if there are any.

156. *Q.* (*Mr. Muir-Mackenzie.*)—Is there any reason to believe that the water-logging which has been observed in certain areas has been proceeding more rapidly in recent years?—That is my impression. I cannot give any very definite grounds for it.

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157. *Q.* In your long experience of Gujerat do you know whether there has been a large extension of water-logging?—Yes, we have heard a great deal more of it in recent years, especially in the Matar Taluka.

158. *Q.* You attribute that to the silting up of the rivers?—Yes, chiefly the Sabarmati; it has become very much silted up during the past fifteen years.

159. *Q.* I understand from your memo. on the Ankleshvar report that you fear the silt would beat all efforts to drain it?—Yes.

160. *Q.* But do you think that the drains which have been made have not even temporarily mitigated the evil?—I have no doubt they have temporarily mitigated the evil.

161. *Q.* Are you able to say whether it would be a long time before the effect of the drains would be neutralized?—It would be some time but not very long.

162. *Q.* Have you seen any of these lands in which surface soils have been injured by drains?—No. I have heard of them.

163. *Q.* You cannot say whether the injury extends over a large portion or the whole of the drain?—I cannot say.

164. *Q.* Do you consider that the rayats are likely to take up considerable sums as advances on their joint responsibility for the purpose of digging tanks or improving old tanks?—No, I have never seen any signs of it.

165. *Q.* You don't think the people are good judges as to sites of tanks?—No.

166. *Q.* Would they make greater mistakes than as regards wells?—They would be much less excusable mistakes.

167. *Q.* I thought you said they were good judges as regards wells?—Yes, they are good judges, but not as good in the matter of tanks.

168. *Q.* You say in paragraph 3 "the people would certainly not take canal water in the black soil country between the Tapti and the Mahi rivers or in the west of the Ahmadabad district. It would also be superfluous in land so retentive of moisture." Would it be superfluous in a year of drought?—No; in such a year as this it would be superfluous.

169. *Q.* What about 1899?—Of course that was different; it would be superfluous this year when the cotton would have done excellently had it not been for rats.

170. *Q.* Would it not pay to substitute rice for cotton cultivation?—I don't think you would gain anything by that.

171. *Q.* Does rice not pay better than cotton?—It may; but I don't think you would gain anything by substituting rice for cotton; they are both valuable crops.

172. *Q.* On the other hand, there would be this advantage that canal water would be available in a year of extreme drought without any loss to the people?—Yes, no doubt the question is whether it would be a gain to Government in ordinary years.

173. *Q.* If rice is more valuable?—It is fully as valuable.

174. *Q.* It might pay a moderate rate?—In an average year rice is grown on the understanding that there will be enough rain to mature it.

175. *Q.* Still tanks are a good protection?—Tanks are chiefly intended for years in which the rains fail, but I don't think the rayat would pay Rs. 7 for a last watering; it is a question I have discussed with men who ought to know what the rayat would be willing to pay for extra water from the canal. Some say he would take water from the canal in any case. I should not have thought so myself.

176. *Q.* It is admitted that salt water is useful for certain crops, such as barley?—Yes.

177. *Q.* It was said yesterday that in certain barley tracts it might be dangerous to sweeten wells?—I should not be inclined to go so far.

178. *Q.* You say in paragraph 6 speaking of irrigation tanks "their necessity is based on the fact that in probably 3 years out of 5 the early rainfall suffices for sowing, transplanting and bringing the rice plants forward, but fails at the last when water is needed to mature them." Is it to be inferred from this statement that in 3 years out of 5 rice is an utter failure?—Perhaps 2 years out of 5 would be safer; in 2 years out of 5 rice crops not protected by tanks are a failure.

179. *Q.* Rao Bahadur Bhimbhai has estimated the area unprotected at two-thirds and that fails?—Yes, perhaps if a rayat could secure a good crop in 3 years out of 5, it would be enough for him.

180. *Q.* With regard to the repairs of tanks, you would be glad to see this 10 per cent. contribution altogether abolished?—Yes.

181. *Q.* In a memo. I have obtained from the Public Works Department I find that in this division there are estimated to be 1,178 tanks requiring repair; the cost is estimated at Rs. 5,30,000; and a suggestion is before the Government that these repairs should be executed systematically throughout the period of 30 years; would that suit the case or would you prefer that the period should be materially shortened?—I should prefer 20 years; I understand that the tanks silt up in that time.

182. *Q.* Now that it has been definitely ascertained that these 1,178 tanks require repair, would it not be advisable, in your opinion, to concentrate famine labour upon these tanks?—Yes, that has always been in my mind.

183. *Q.* (*Mr. Ibbetson.*)—Is the sum of Rs. 5,30,000 annual or spread over 30 years?

Mr. Muir-Mackenzie.—That is the total amount.

Witness.—I believe the reason why more has not been done is because they are small works and there is a general objection to small works.

184. *Q.* (*Mr. Muir-Mackenzie*)—The fact of their being small works would not make it impossible to take them up as works of famine administration?—It would certainly be more difficult but not impossible.

185. *Q.* Would it require much revision of the existing programme?—No, in the programme a number of works are clubbed together.

186. *Q.* With reference to what you say in paragraph 8, the whole question of remission of land revenue is under the consideration of Government; is it not?—Yes.

187. *Q.* Up to the last cycle of bad years do you think the people have found serious difficulty in paying their rice assessment?—It must have gone very hard with a man who lost the whole of his crops.

188. *Q.* Has there been any difficulty in getting it out of them?—No, his land is too valuable to risk and he could always raise the assessment from the *sowcar.*

189. *Q.* With regard to what you say in paragraph 13 about wells, your general view is that only a substantial man will come forward and execute works likely to pay, but does not the general argument you have used militate against the giving of water cheap by Government; at least by the large system of canals as in Northern India?—As I understand, the canal water is laid on the ground by natural flow almost invariably; the canal rate would not be much more than the equivalent of the labour of lifting water thus saved; in the case of a well the cultivator has to incur heavy expenses, quite apart from the cost of sinking; that is, bullocks and labour.

190. *Q.* I understand that you prefer the system under which the cultivator will get his water dear?—I look upon that as a check against injudicious irrigation to which I attach the greatest importance.

191. *Q.* Supposing the advantage to the land from the water to be equal, would you prefer to see land in Gujerat irrigated by wells rather than by canals?—In Gujerat certainly.

192. *Q.* I believe you strongly approve of the grant of *takavi* liberally in the early stages of famine for *kachcha* wells?—Yes.

193. *Q.* Would the end of October be too early if rain has failed by the end of September?—No.

194. *Q.* Do you think the people will again become backward in taking *takavi* when good years return?—I cannot say; the low rate of interest charged by the *bania* may be an obstacle; that is one argument for lowering our rate.

195. *Q.* You have suggested that Government should take precautions to find out whether, by boring, a well is likely to succeed; would the *data* collected by the Survey Department be of considerable use?—They might be of some general use, but boring on the spot is the only thing.

196. *Q.* Would drainage, in your opinion, be an effective remedy for salt efflorescence or deterioration caused by over-irrigation?—I think that is the generally accepted view; I know nothing about it myself.

197. *Q.* You said a *bania* often supplies the capital for a well and takes a share of the produce; would it not be advantageous for Government to supply the capital for the

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well and take instead the *bagayat* assessment?—I don't see why that should not be done.

198. *Q.* You have no objection to seeing it offered?—No.

199. *Q.* You don't think it would create mistrust, as engendering the idea of enhanced assessment?—Not, if properly managed.

Mr. J. Mollison.

Mr. J. Mollison, M.R.A.C., Inspector-General of Agriculture in India.

(*Surat, 10th December 1901.*)

Letter from witness to the Chief Secretary to Government, Revenue Department, Bombay, No. 21, dated the 16th November 1901.

In reference to your No. 2282, dated the 26th October 1901, Famine Department, I have the honour to offer the following remarks on extension of irrigation throughout the Bombay Presidency.

2. During 11 years' work in the Presidency I have gained a fairly accurate knowledge of the agricultural conditions existing in each collectorate.

3. In the following Note I refer separately to agricultural conditions and facilities for successful irrigation as they exist in (A) Gujerat, (B), the Deccan and Southern Mahratta Country. I do not think it is necessary to include in the inquiry the Konkan, Kanara or the Southern talukas of the Surat district. In these tracts the rainfall is generally so heavy and assured that rice is the staple crop. There has in these parts occasionally been partial crop failure from scant rainfall, but there is much more pressing need of extended irrigation in other parts of the Presidency.

4. In Gujerat the soils vary considerably in character. Some of the soils can be successfully irrigated; others cannot.

5. In considerable portions of Ahmadabad, the Panch Mahals, Kaira and in adjoining Baroda territory the soil is deep alluvium. It varies in character from a light sandy loam to a stiff loam. These alluvial soils extend to a depth of 40 feet or more, often without any change in character or consistence. The older existing wells usually hold an unfailing supply of water. The water in some wells is sweet; in others brackish. Wells with sweet and brackish water are commonly found very close together. The water from brackish wells is specially suitable for tobacco, but it may not be so salty as to be unsuitable for other crops. The initial cost in determining whether a well is likely to yield sweet or brackish water is small.

6. In these alluvial plains there is considerable scope for extension of successful irrigation from wells. Such extension would require not only large initial outlay, but large recurrent expenditure, because the wells would be costly in construction and the permanent water level being low, the cost of raising water would be high. It is certain, however, that the average cultivator in these parts before the last famine was tolerably well circumstanced. The Charotar villages of Kaira and of Baroda territory are probably as fertile as any in India and the average Kunbi cultivator in them has or can provide sufficient labour and manure to do full justice to any extended scheme of well irrigation. In the famine year (1899-1900) the cultivators of these Charotar villages, as also generally throughout the alluvial plains of Northern Gujerat, helped by small *takavi* advances from Government, set themselves to dig *kachcha* wells in large numbers. The cost of digging through the soft alluvial soil was trifling. A *takavi* advance of Rs. 25 or Rs. 30 was sufficient for digging a well and for the leather bag, rope and other fittings. The perpendicular sides of these *kachcha* wells were very solid, and it was exceptional to find a *kachcha* well falling in during the fair season. These wells were, of course, useless after the following monsoon. Many of them gave a full supply of water throughout the season. One year of the drought does not materially lessen the supply of water in good wells in this tract.

7. It is not possible to dig *kachcha* wells so successfully in black soil or mixed black soil tracts, because the wells, after use for a short period, have a tendency to fall in.

8. In the alluvial tract of Northern Gujerat there are a good many low-lying situations which are suitable for rice. The position is improved by artificial *bunds* round the rice beds, but the rainfall is usually insufficient for rice and without artificial means of irrigation for two or three waterings towards the end of the season the crop is precarious. Such irrigation is obtained to some extent from wells, also from tanks. Greater protection by tanks or wells is required particularly in the more extensive rice areas, as, for instance, in the Mehmadabad taluka of the Kaira district and in the western talukas of Ahmadabad.

9. In the wheat and cotton growing parts of Ahmadabad, also in parts of the Panch Mahals and Kaira, the soil is black or mixed black. It varies considerably in depth and character. The substrata also vary. Below the black soil may be found light-coloured argillaceous layers more or less concreted with lime and consequently more or less impervious to water. These combinations of soil and subsoil when impervious are not well suited for successful irrigation of the ordinary crops. In the black soil parts of Ahmadabad the rainfall is usually light. There are, however, a good many situations where rice beds assisted by tank irrigation have been successfully formed and there is probably considerable scope for extension and for further protection either by small tanks or wells.

10. In the Kaira and Ahmadabad districts there are certain salt lands existing in some places in patches; in other places in more extended areas. Wells constructed in such areas have usually brackish or salt water useless for irrigation. After a year of drought in these salt land areas well water, which is usually slightly brackish, may become intensely so.

11. *Pakka* built wells of ordinary depth and capacity generally throughout Northern Gujerat cost Rs. 1,000 to Rs. 1,500 each and large wells capable of working four lifts (*kos*) much more. The deep alluvium of Kaira and Ahmadabad, particularly if sandy in character, needs water very frequently and a single *kos* will not irrigate more than two acres. Gujerat wells are, however, usually capable of keeping two or more *kos* at regular work.

12. In the famine year (1899-1900), although the general area under irrigation in the Presidency declined, the well-irrigated area increased by about 100,000 acres. More than three-fourths of this increase occurred in Kaira and Ahmadabad, although the water of many of the old wells in the black soil parts and in salt land villages became too salty for irrigating crops. The rice areas were largely unsown and the tanks throughout these districts dried up. I can from personal knowledge say that the fodder produced from well-irrigated crops throughout Northern Gujerat in 1899-1900 was the means of keeping alive many of the cattle which survived the famine. The value of cultivation of this kind in producing food for men and beast, in providing useful home labour and in keeping people off relief works cannot be lightly discounted. I believe that a *pakka* well could, with advantage, be constructed in every position occupied by a *kuchcha* well in the late famine and in thousands of other favourable positions throughout the alluvial tracts of Northern Gujerat. Such wells would be uncommonly useful in an ordinary season and in a year of drought or famine would provide water sufficient for very extensive irrigation.

13. In the famine year it was possible to irrigate from a two-*kos* well three crops on three different areas covering altogether 10 or 12 acres of ground. The three successive crops in Northern Gujerat were ordinarily Sundhia *jowar* sown in September, wheat sown in November-December and Sundhia or Chino (Panicum miliaceum) sown in March-April. The grain of Sundhia is of trivial value, but the fodder is very fine and nutritious, and a fair average crop produces about 6,000 lbs. of dry fodder per acre. A good crop of irrigated wheat in Gujerat yields over 2,000 lbs. of grain and 2,500 to 3,000 lbs. of straw per acre, but owing to rust wheat is a risky crop in Gujerat. The hot weather crop of Sundhia does not on an average yield so heavily as the earlier crop. There was no dearth of manure in the famine year, because it was not required for dry crop cultivation. The whole supply of the year was available for well-irrigated patches and the crops produced were enormous.

14. Throughout Broach, excepting the alluvial belt along the Tapti and the sandy belt along the coast, the soil is deep black cotton soil. On such land rice beds have been successfully formed under village tanks and more could be formed. The soil is entirely unsuitable for the cultivation of other crops under well or canal irrigation, because it is extremely deep and retentive of moisture and the substrata are impervious.

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15. The soils in the northern cotton-growing talukas of the Surat Collectorate are more variable. There are the rich alluvial *bhata* soils which fringe the Tapti and extensively grow valuable garden crops under irrigation from shallow wells. Throughout the district there are a number of garden villages with considerable areas of alluvial soil somewhat similar to *bhata*. These grow a great variety of valuable garden crops under well irrigation. Generally, however, the soil in the northern talukas of Surat is deep and black and chiefly grows dry crops of cotton and *jowar*. In parts the soil is more mixed in character and in such places well irrigation is extending. I refer in particular to clay loam (*kali besar*) soils adjacent to the alluvial lands of garden villages. Such mixed black land has extensively been brought under well irrigation since Revision Survey. The reasons are that the land is suitable for irrigation; the occupants are men of means and now enjoy assurance of tenure at a fixed rent for a definite term of years. On this class of land there is scope for extension of irrigation—perhaps also in the Surat district on mixed black soil of heavier character, but there are certain risks in constructing wells on such heavier land which ought to be referred to. It is uncertain whether a well, when constructed, will yield sweet or brackish water. Water which is sweet early in the season may turn brackish during the hot weather. Brackish water for irrigation deteriorates temporarily or permanently mixed black soil and on any soil is only suitable for certain crops. In the black soils of the northern talukas of Surat, as in Broach, more tanks for rice irrigation could with advantage be constructed.

16. In paragraph 4 of the memorandum of points to be considered by the Irrigation Commission there is a question of utilizing the waters of the Nerbudda, Tapti and Sabarmati. The waters of the two former rivers could only in Gujerat be diverted to irrigate black soil areas which are to a very large extent quite unsuitable for irrigation. The waters of the Sabarmati or any other stream which flows through the alluvial plains of Northern Gujerat would be extremely useful for irrigation, provided the lands irrigable consists of light or comparatively light alluvial soil; but if this proposed system of irrigation is carried through the low-lying black soil *rabi* areas of the western talukas of Ahmadabad, it is almost certain that the results would be unsatisfactory.

17. The information given in the foregoing paragraphs in reference to the various districts of Gujerat indicate that considerable extension of irrigation is practicable. There are, however, risks which must be kept well in view.

18. In parts of the Deccan and of the open plains of the Southern Mahratta Country the water in the wells got so low in 1899-1900 that irrigation was intermittent. This was not the result of one season of drought, but of several seasons of scant rainfall. The famine year 1896-97 caused extreme drought over the greater part of the Deccan, and the more open plains of the Karnatak, still in these parts, in that year, the wells held sufficient water for very extensive irrigation. There was then considerable activity in constructing new wells and in deepening old wells to increase the water-supply. Large portions of the Deccan and the Karnatak are extremely liable to seasons of drought, but it is difficult to believe that these parts will again have a succession of seasons so disastrous as those which began with the famine of 1896-97 and culminated with that of 1899-1900. During that period in places the water in the wells got so low that even drinking water became scarce. Still statistical figures show that excepting Poona and Sholapur there was in 1899-1900, a considerable increase of irrigation under wells in all districts of the Deccan and Karnatak as compared with the year before. In these districts the protection afforded by wells against drought is, in my opinion, much more satisfactory than that afforded by tanks or larger irrigation works. After years of scant rainfall the tank and canal supplies fail just when the water is most required, and it can be put in evidence that some at least of these larger irrigation works are not an unmixed blessing in other respects. I can call to mind several inquiries which the Bombay Agricultural Department was asked to institute in recent years regarding damage done to land by tank and canal water in causing water-logging, salt efflorescence, etc. Considerable damage has been caused by *reh* under the Nira Canal. The Manjri and Mundwa sugarcane area has been flooded to excess by the Kharakwasla Canal for a number of years. A good deal of land which was formerly cultivated has by excessive water-logging been converted into swamp and owing to unhealthy conditions produced by wetness of soil. The crops of cane now grown are not nearly so good on an average as they were 5 to 10 years ago. I can, if questioned by the Commission, give detailed reasons for these failures and for other failures of irrigation works throughout the Deccan and Karnatak.

19. There are various reasons why irrigation from wells cannot be indiscriminately extended. The cost of raising water from a depth of 25′ or 30′ as in the Deccan is heavy and is particularly so from the deep wells of Gujerat which range in depth from 40 to 60 feet. This cost is so great that only a *good* well irrigated crop can pay. A good crop under ordinary circumstances can only be produced if heavily manured, carefully cultivated and regularly watered. This necessarily restricts the area which can be successfully irrigated from wells to such situations as have at reasonable depth tolerably certain supplies of sub-soil water in ordinary seasons. It also restricts the cultivation of well irrigated crops to cultivators in easy circumstances, to men who have the means or the credit to provide sufficient manual labour, sufficient manure and sufficient work cattle. Perhaps it would be possible for a few years to grow on the very rich alluvial soils of Gujerat successive unmanured crops which would pay, but such practice would cause soil exhaustion in a very short period in ordinary Indian soils. Valuable crops grown under wells must necessarily be watched by the owners. Therefore it is not likely that such cultivation will extend far from the village sites.

20. Irrigation from a tank or canal is cheaper than from a well, but with any system of irrigation heavy applications of manure and specially careful cultivation are necessarily required to give profitable results in average seasons. In years of absolute drought waterings as required would, however, without manure or special tillage, be extremely beneficial on such land as is suitable for irrigation.

21. I have stated certain circumstances which will restrict the successful extension of any system of irrigation in the Presidency. In my opinion the chief restriction to this or any other agricultural improvement will be found in the large and general indebtedness of the agricultural classes to the Banias. I see no hope of special agricultural advancement in the Bombay Presidency until this incubus of debt is removed. It practically paralyses every effort towards improvement. I would be prepared to recommend that Government should once for all liquidate the debt in some fair and reasonable way and make it impossible afterwards for the cultivator to borrow on the security of his land. Then it would be impossible for him to waste his substance in useless caste ceremonies to the extent that he does now. There is no doubt that the general outturn of crops in the Bombay Presidency is in ordinary years very seriously affected by the indebtedness of the cultivators, because they are not in a position to cultivate to the best advantage.

22. Throughout the Presidency generally the oldest well may generally be said to occupy the best positions. This indicates on behalf of the people an intimate knowledge of the most favourable conditions for successful well irrigation. In the rolling uplands of the Deccan and Southern Mahratta Country (excluding the red laterite soils in the west of Belgaum and Dharwar), it may be definitely said that the most favourable positions for wells are the bottom lands consisting of mixed black soil 18″ to 4′ deep overlying *muram* with unchanged trap still lower down. These substrata are pervious to water and secure natural drainage—very important considerations when land is continuously irrigated. There are throughout the Deccan and Southern Mahratta Country very numerous situations where wells can still with great advantage be constructed. Fringing the most important rivers of the Deccan and Southern Mahratta Country, such as the Tapti in Khandesh, the Godavari in Ahmadnagar, the Krishna in the Southern Mahratta Country the soil is deep black. It gets sodden and wet in the monsoon. It is extremely retentive of moisture. It is not pervious and therefore like the deep black soil of Broach is unsuitable for growing irrigated crops. Such lands are specially suitable for dry *rabi* crops.

23. The best wells in the Deccan and Southern Mahratta Country keep two or more motes (leather bag lifts) actively at work in ordinary years. A single mote will from a good well of moderate depth irrigate 3½ to 4 acres of such crops as require light irrigation, *e.g.*, wheat, onions, and 2 or 2½ acres of such crops as require much water, *e.g.*, sugarcane.

24. In the 1899-1900 famine year the area under well irrigation in the Presidency was considerably extended through *takavi* advances for constructions of *kachcha* wells and for deepening and repairing old wells. These advances were not so serviceable in the Deccan and Southern Mahratta Country as in Gujerat. Special officers were employed to deal with applications for *takavi*, but could not complete all inquiries in the Deccan and Southern Mahratta Country

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soon enough to make the advances serviceable. It takes some time to sink a well through hard trap in the Deccan. In a famine year the water level is lower than usual and as the season advances gets lower day by day. *Rabi* irrigated crops can only be sown seasonably during a certain period. It is therefore practically useless in a famine year to give *takavi* for wells except for deepening after November-December.

25. It may be inferred from the last paragraph that I advocate the need of liberal *takavi* advances in ordinary years rather than in famine years for well construction. Preliminary inquiry, which must take time, is necessary before *takavi* can be given safely for wells. This inquiry can only properly be made by experienced practical men. A man with sufficient knowledge of all the circumstances connected with successful extension of well-irrigation would have no difficulty in disposing of numerous applications in a short time. He could take district by district, and to begin with sanction advances only to tolerably well-to-do cultivators and by preference select the more favourable positions. An experienced practical man with an intimate knowledge of native character if put on special duty would in a single season be able to dispose of many applications if he took up district by district in a systematic way and thoroughly exploited each. He would be handicapped in his work in an intolerable way if loans when sanctioned are not promptly paid in full. Such loans would be more freely taken by the people if the present 6 per cent. rate of interest was lowered. It is currently believed that the *takavi* system is unpopular because controlled to some extent by subordinate Government officials who for personal gain make a substantial deduction from each loan.

26. Complaints are made that successful applicants for *takavi* do not always spend the loans in the manner contemplated by Government. If it can be proved beyond question that loans given for well construction are generally misapplied, then I think Government should undertake the construction of wells in the same way as any other irrigation work. A cultivator can construct a well cheaper and probably as well as by Government agency, and it is probably preferable that he should himself undertake the work, but it may be found necessary to employ Government agency. In that case I urge that the occupant of the land should have the option to cart all material and with his family do all digging and rough work requiring ordinary labour. The value of such work at ordinary hiring rates to be deducted from the total outlay, the difference should be a burden on the land recoverable like assessment—principal and interest to be repayable in easy instalments spread over a long term of years. Government should bear all loss if the well fails to provide a full supply of good water at a reasonable depth in a year of average rainfall.

27. Under existing conditions the administration of the *takavi* system, the agricultural development of the Bombay Presidency, and the general efficiency of the Revenue Service are greatly hindered, because the men employed in the Subordinate Revenue Service are not properly trained to their work. This will soon in part be remedied. As bearing on existing inefficiency I put the following note * before the Famine Commission, which I do not wish to modify in any degree:—

* Paragraphs 28 to 34.

"28. I feel strongly that the Bombay Subordinate Revenue Service would be considerably strengthened if recruited more extensively by agriculturally trained men. The rules regulating the work of Circle Inspectors, District Inspectors and Superintendents of Land Records and Agriculture clearly contemplate that such officers should have special knowledge in agricultural and survey. work. It is clearly laid down that Circle Inspectors shall watch the season in their circles, and detect as early as possible signs of crop failure and coming distress. They must watch fluctuations in prices, the conditions of the people, cattle and crops, the supply of drinking water, diseases affecting man and beast. They are required to study the varieties of crops and crop mixtures, rotations, cultivation, manures, crop diseases and blight; also to estimate outturn in annas. They must check returns of population and agricultural stock, village estimates of areas under different crops, also irrigated dry-crop and doubled-cropped areas. The Circle Inspectors must further be educated in survey work as measurers and otherwise.

"29. The District Inspectors and Superintendents of Land Records and Agriculture exercise a superior check on the work of Circle Inspectors. Statistical and other returns are passed on by Circle Inspectors through District Inspectors, Mahalkaris, Mamlatdars, Assistant Collectors and Collectors to the Director of Land Records and Agriculture, for compilation.

"30. It is, I think, certain that approximate accuracy in agricultural and statistical village returns can only be secured if supervised by agriculturally trained men. At present the Circle Inspectors in the Bombay Presidency, who do the most reliable work, are, I believe, old survey men, who, owing to the winding up of the survey, have been compulsorily retired from that department. They were trained in that department to active out-door work and to appreciate in a practical way agricultural facts and operations, and as Circle Inspectors such training has been found valuable.

"31. It is unlikely that agriculturally trained men will accept Circle Inspectors' posts of Rs. 25 per mensem unless they can by ordinary promotion and good work rise in time to be Mamlatdars. I do not suggest the necessity of special promotion for any agriculturally trained man. At the same time there can be little doubt that such men as show special aptitude and reliableness at work would have more or less of a lien on such posts as District Inspectors, Price Inspectors, Superintendents of Land Records and Agriculture, and in responsible posts in the Department of Land Records and Agriculture. The clerical and supervising establishments controlled in his own office and on Government farms by the Deputy Director of Agriculture should be recruited from agriculturally trained men whose prospects of promotion should not be inferior to the prospects of men who join the Revenue Service.

"32. It is necessary to explain the term 'agriculturally trained'. The Bombay University gives a degree in agriculture. The syllabus has recently been revised and the pass test stiffened. In order to gain the degree a thorough practical out-door or field knowledge is now fully as essential to the student as book or class-room learning. The course extends over three years. A student must pass the Previous Examination, which is a higher test than Matriculation, before he can enter the agricultural course at the College of Science, Poona. This preliminary test is the same as for students who go up for other University degrees and is a guarantee of sound general education. Afterwards the agricultural student must pass three University examinations. The first before he can pass to the second year's course, the second before he can pass to the third year's course, the third in order to get the degree. The practical training can adequately be given at the Poona Government Farm (on which are residential quarters for students) and by excursions. As far as possible object lesson plots are arranged annually to familiarize students with numerous field and garden crops of the Presidency and the conditions under which they are successfully grown, and further to illustrate, practically in the field, the class-room teaching. There is a complete collection of indigenous agricultural implements at the farm and an excellent museum collection of agricultural and economic products at the College and in the Director of Agriculture's office. The teaching staff and equipment at the College of Science are sufficient.

"33. The Bombay Government has ruled that in future agricultural degree-holders shall gain admissions into the Revenue Service on precisely the same footing as other University degree-holders. The effect has been that the agricultural classes at the College of Science have revived. They had dwindled to a single student in 1899. Twelve joined in 1900, and I understand that 13 new students have joined this month (January 1901). Poona will be a centre of training for other provinces as well as Bombay, and I urge the need of a general ruling regarding the employment of such men in all provinces and particularly in the Department of Land Records and Agriculture. In the latter Department, even in Bombay the prospects of graduates in agriculture are indefinite.

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"34. I advocate strongly that Bombay Civilians, after they are, say, a year and-a-half in the country, be sent to the Deputy Director of Agriculture during the monsoon in Poona for two months to be taught something regarding the crops, the implements, the soils, the cattle and generally regarding the agricultural conditions of the Presidency. I am sure they would find such teaching valuable afterwards in ordinary district routine work."

35. It is impossible to state, except in general terms, the increase of produce obtained by the various systems of irrigation throughout the Presidency. The conditions vary extremely between districts as regards the kinds and value of crops, which can be successfully grown, as regards available supplies of manure, as regards the adequacy or precariousness of water-supply, and as regards actual cost of applying irrigation; therefore the question of profits can only be generalised. I am prepared to discuss orally the conditions as they exist in the various districts of the Presidency.

36. It can be put in evidence that the supply of water in existing wells has been considerably improved in years of drought by deepening and by boring in various parts of the Presidency. The Agricultural Department is, I believe, collecting detailed information. The evidence at hand clearly indicates that owners of existing wells might be helped considerably if proper boring apparatus was made available in the various districts. The rude boring apparatus now in use can only be successfully employed when the substrata are comparatively soft and free from layers of fine sharp sand.

37. Reference has already been made in this note to the necessity of extra supplies of manure for any extended scheme of irrigation. The important question is: "Are such supplies procurable?" It may be answered in the affirmative. There is evidence at hand that when manure is urgently needed for irrigated crops supplies, which are ordinarily at hand and not generally used for dry crops, are eagerly in demand for irrigated crops. I can, from personal knowledge, state that in every district where well irrigation is extensively practised that the dung and urine of cattle, litter, leaves, tank mud and other useful organic matter, household waste and in some out-districts night-soil, are collected with scrupulous care and are much better conserved than before there was extension of well-irrigation. In the neighbourhood of some large towns poudrette is freely used for irrigated crops. It is dear where there is great demand, and cheap where the demand is limited. The extension of the important market garden cultivation in the neighbourhood of Surat has been dependent upon supplies of town manure, chiefly crudely made poudrette. The stuff is still sold at a cheap rate because supplies are yet more than sufficient for requirements. The Bombay Agricultural Departmental experiments with sugarcane at Manjri near Poona have proved that certain edible cakes which can be procured in large quantity at cheap rates give better results than the manure cakes in ordinary use. These manure cakes (castor and *karanj* cakes) are dear because largely in demand for irrigated crops. The cane cultivators have recognised the special value of the edible cakes referred to, and are now using them in the Poona district as manure for sugarcane. The practice of growing San (Crotolaria juncia) and other leguminous crops, as green manures, will become more common as well-irrigation extends. Everywhere in the Presidency the system is already recognized as a very useful source of manure.

I do not think that the cultivators of irrigated crops in the Presidency require to be taught anything regarding the value of rotation as a substitute to some extent for manure. Under canal irrigation probably sugarcane and some other crops are taken too often in succession, but usually under well-irrigation a remarkable knowledge of scientific rotation of crops is shown.

38. I have found it convenient to give information regarding the various questions put by the Irrigation Commission in narrative form. I hope I am not out of order in doing so.

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1. *Q.* (*The President.*)—You have been 11 years in this Presidency, I understand?—Yes, I was first Superintendent of Farms and then Deputy Director of Agriculture in Bombay and now hold a Government of India post.

2. *Q.* Are these farms your creation?—The Surat and Manjri farms are; the Poona farm existed before I came to the country; it has been extended a good deal since to carry on special experiments and special work.

3. *Q.* You say in paragraph 5 of your note that the initial cost in determining whether a well is likely to yield sweet or brackish water is small?—Yes, it is trifling in Gujerat but serious in the Deccan. In Gujerat you have to dig through comparatively soft soil before you get to the water-bearing stratum; in the Deccan you would have to dig first through soft materials and afterwards through hard *muram* and trap rock, causing great expense. The actual stone or brickwork building is not so expensive in the Deccan as in Gujerat because the hard trap takes the place of actual building to some extent in Deccan wells. Sometimes a Deccan well is only built up in the side on which the leather bag works.

4. *Q.* Supposing an ordinary cultivator wishes to place a well near his village, how does he set about finding whether the water is salt or sweet?—There would be no great risk in the Deccan, because salt water is rarely met with; in Gujerat there is grave risk in some tracts of getting brackish water; he cannot make certain; he must do the *kachcha* work.

5. *Q.* Do you recommend getting boring instruments in each district of a superior kind and a mechanic to work them for the sake of giving this information to the people?—I should like to test that plan before it is applied extensively; I should not like to do it wholesale.

6. *Q.* Natives have boring instruments of some sort?—Yes, but they are not applied to initial work, but in existing wells to deepen them and find a lower stratum of water.

7. *Q.* There is no doubt that by the use of Norton's tubes one could find this out?—Yes, specially in Gujerat where it is easy to work in the soft alluvial soil and subsoil.

8. *Q.* We have had a proposition that it would be a good thing to have at each of the district head-quarters boring apparatus which could be lent?—Yes, it would be a good thing.

9. *Q.* You say in paragraph 6, talking of the *kachcha* wells, "these wells were of course useless after the following monsoon" and again in paragraph 7 "it is not possible to dig *kachcha* wells so successfully in black soil or mixed black soil tracts, because the wells after use for a short period have a tendency to fall in"?—*Kachcha* wells in alluvial soil last until heavy monsoon rains loosen the sides, then they have a tendency to fall in. *Kachcha* wells in *bhatta* soil on the banks of the Nerbudda and Tapti are dug at a trifling cost every year; the depth to water is sometimes only 12 to 13 feet. The silt of flood water fills most of these wells up annually.

10. *Q.* (*Mr. Ibbetson.*)—Have you any tracts in which a *kachcha* well would last five or six years?—Yes, in parts of the Panch Mahals and in the black soil parts of Ahmadabad; also generally in the Deccan *kachcha* wells would last for some years; the cost of making them *pakka* would not be great, and, therefore, there would be no particular advantage in leaving them *kachcha* for any length of time.

11. *Q.* (*The President.*)—Is there any rice irrigation to speak of on wells?—Not much on wells alone, but there is the risk of a tank failing towards the end of the season and the owner of the crop would be glad to have a well at hand.

12. *Q.* (*Mr. Muir-Mackenzie.*)—Do they use wells for rice?—Yes, they do, only as an auxiliary to tank irrigation; if a tank fails rather than lose the crop, they would irrigate from wells.

13. *Q.* (*The President.*)—Do you attach much importance to the extension of tank irrigation and the repair and maintenance of tanks?—Yes, a good deal of importance, particularly if the tanks are small and if the people of each village control the distribution of water from their own tank; I would consider an extension of small tanks thus used much more important than the extension of large tank irrigation which could not be equally well controlled by village communities.

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14. *Q.* Still the water lasts longer in a big tank?—I have seen big tanks in the Deccan where the disadvantages outweigh the advantage you refer to.

15. *Q.* Of course the size of the tanks must depend upon the configuration of the ground?—Quite so, not so much in Gujerat, because it is a comparatively level tracts In almost any position you could make a tank if you could get a little flow of water, because the depth of black soil is such that you could remove a foot of the surface soil without lowering the fertility.

16. *Q.* I suppose you would count upon cultivating the bed of the tank when the water is off?—As a matter of fact, this is not an uncommon practice in the Presidency.

17. *Q.* You say in paragraph 11 "the deep alluvium of Kaira and Ahmadabad, particularly if sandy in character, needs water very frequently, and a single *kos* will not irrigate more than 2 acres." And again in paragraph 13 "in the famine year it was possible to irrigate from a two-*kos* well three crops on three different areas covering altogether 10 or 12 acres of ground." I suppose a double-*kos* well would do twice as much work as a single one?—Yes, if the land is near, each *kos* would, if the water lasts, irrigate 6 acres between September and the following May. Three crops, each occupying 2 acres, would be taken in succession on different areas commanded by the same well.

18. *Q.* Would that be a *kos* working day and night?—Yes, but only towards the end of the season, but not necessarily between September and February.

19. *Q.* Did the level of water in the wells sink much in the famine?—In the famine year one season's drought did not materially lower the depth of water in the older and better wells in the deep alluvial tract of Kaira and Ahmadabad and the Panch Mahals.

20. *Q.* (*Mr. Muir-Mackenzie.*)—Do you say that from personal observation?—Yes, one year's drought does not diminish the supply until the following hot weather in the alluvial tract. In the black soil the supply did fail.

21. *Q.* (*The President.*)—You say in paragraph 12 "the fodder produced from well-irrigated crops throughout Northern Gujerat in 1899-1900 was the means of keeping alive many of the cattle which survived the famine; what happened to the cattle where there was no well-irrigation?—They mostly died. We have in the Bombay Presidency 4 million less cattle than there was in 1896-97; the traffic in hides in Gujerat and adjoining Native States in the famine year indicated that the chief losses which occurred that year occurred in these parts. Our census, which was taken in June, indicated that nearly 70 per cent. of the Kaira, Ahmadabad and Panch Mahals cattle died, and that is, I consider, an underestimate, probably before the rains came more cattle died. The change from dry fodder to green food at that particular season is so severe that it is the cause of mortality in any year and was probably the cause of great mortality in the famine year when the cattle were much reduced in condition.

22. *Q.* You say in paragraph 14 "throughout Broach excepting the alluvial belt along the Tapti and the sandy belt along the coast the soil is deep black cotton soil. On such land rice beds have been successfully formed and irrigated by village tanks and more could be formed. The soil is entirely unsuitable for the cultivation of other crops". Is the soil upon the alluvial tract suitable for irrigation?—It is well protected by irrigation from shallow wells now.

23. *Q.* How wide is this belt?—Not a mile wide; the Nerbudda belt is wider.

24. *Q.* Would the alluvial tract on the Nerbudda be helped by a canal?—It is very narrow. A canal would do no harm. I think a survey should be made. I am not very well acquainted with the whole tract. I should say the extent is such that it is not worth while to construct a canal specially for it. The alluvial belt on the Tapti is protected by *kachcha* wells which are dug every year, or on higher lands, by *pakka* wells.

25. *Q.* Have you seen anything of the pumps for raising water from rivers?—I know a little about them but not much.

26. *Q.* Is this system coming into vogue here?—At Nausari, in Native State territory, a man intends to do a little in that way.

27. *Q.* Do you believe in it?—Yes, if the soil is suitable.

28. *Q.* Would it stand the expense?—Fuel is expensive; probably the cost would be found, after inquiry, to exceed well irrigation by bullocks, but I am speaking without any definite knowledge.

29. *Q.* I understand that you think on black soil rice can be irrigated with advantage?—Yes, by means of small tanks.

30. *Q.* Could it be irrigated by a canal?—Not with advantage in any part of Gujerat, because such irrigation would spoil more land than would be under rice. By leakage from the canal, I should expect water-logging and salt efflorescence, and I also think that the people would not use canal water so economically as well as tank water for rice.

31. *Q.* The question is whether you can utilize the water of these rivers or should you allow it to go to the sea?—I should be sorry to see a large scheme tried in either Broach or Surat; I would rather see the water wasted than used there; I should expect that a good deal of land would go out of cultivation and that a good deal of land would be spoiled.

32. *Q.* Water-logging can be remedied by drainage?—Still you have the extra expense of drains; the chances are that open drains would want to be cleared every year. They would be filled up with black soil. That has been our experience on the Surat farm.

33. *Q.* Still it is just a matter of money with you?—I should be very sorry to see a canal carried where we have black soil, especially for rice cultivation; pure black soil is absolutely unsuitable for any irrigated crop except rice. Deep black soil, as you find it generally in Gujerat and in practically the whole of Broach, holds when wet a large quantity of water and the subsoils are of clay-like character and therefore impervious to moisture; when you have that combination the conditions are such that no irrigated crop can be successfully grown except rice. There are in the Surat district restricted areas of soil which is not pure black. That portion of the Surat farm which is irrigated has soil of this class. We have found that the value of the crops grown under well irrigation does not warrant the expenditure incurred for deep wells, heavy dressings of manure and drainage. No ordinary cultivator would have incurred the expense.

34. *Q.* Our particular object is to inquire into the means of protection against famine; it is a serious responsibility to reject two large rivers?—I can only say that according to my convinced belief canal irrigation for rice in the black soil parts of Gujerat will do no good. It will probably do harm, and I should be sorry to accept the risks. The case is entirely different in respect of the alluvial soils of Northern Gujerat and of Baroda territory.

35. *Q.* Have you seen the irrigation in the Madras deltas?—No.

(*Mr. Rajaratna Mdlr.*)—The soil there is not true black soil.

36. *Q.* Do you know the Tapti district?—Yes.

37. *Q.* What is the soil like?—The soil throughout Khandesh for 2 or 3 miles on either side of the Tapti is like that in Broach, then you get into uplands where the black cotton soil is 3 feet deep or less overlying *muram*. On the black soil along the Tapti it is only possible to grow *rabi* crops because the soil gets so sodden that no *kharif* crop will grow. In this river-side tract *rabi* dry crops of wheat, gram and linseed are taken in rotation. Khandesh is a *kharif* district except in this belt.

38. *Q.* (*The President.*)—I understand that while down here in Broach and Surat there is a belt of alluvial soil which stands irrigation; further up the river-side belt consists of deep black soil?—Yes.

39. *Q.* Is it safe to irrigate on *gorad* land?—Yes, perfectly safe.

40. *Q.* Do you know anything of the proposed irrigation works of the Sabarmati?—No.

41. *Q.* Have you seen the Hathmati?—No.

42. *Q.* Nor the Khari cuts?—No.

43. *Q.* I have been puzzled how it is that in this country there is very little irrigation bestowed on cotton; in Egypt it is a highly irrigated crop; why is that?—Egyptian cotton differs in variety from any indigenous Indian variety; that may be one reason.

44. It is not impossible to irrigate cotton in this country?—If a man goes in for irrigation at all, he selects crops which will pay better than cotton, such as garden crops.

45. In Egypt you could not possibly grow cotton without a good deal of irrigation?—In Egypt you are dealing with alluvial soil; in the Bombay Presidency the cotton soil is chiefly black soil which does not suit irrigation.

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46. *Q.* In Egypt it is not that the crop won't stand it, but it cannot possibly do without it?—That country has very little rainfall; Broach has a rainfall of over 40 inches; I should say that the circumstances are such that you require irrigation in Egypt but not here, with the rainfall that is usually got.

47. *Q.* Do tanks ever get brackish?—Not in my experience, but I cannot speak positively.

48. *Q.* You say in paragraph 17 "the information given in the foregoing paragraphs in reference to the various districts of Gujerat indicates that considerable extension of irrigation is paracticable; there are, however, risks which must be kept well in view." To what do you specially allude?—To the risk of getting salt water in the wells, for instance.

49. *Q.* Have you had any experience of the effects of drainage on water-logged land?—No, I should like to try the experiment. In one taluka of Surat a good deal of land has gone out of cultivation owing to the effect of water-logging. In this water-logged area the crops are not so valuable and more risky to grow than those on drier land; people have been compelled to grow *rabi* crops instead of *kharif*. I don't see any reason why, by drainage or other improvements, land that has got out of cultivation should not be successfully brought under cultivation again.

50. *Q.* What is the taluka you spoke of?—Olpad.

51. *Q.* Can one buy artificial manure here and is it within the range of the cultivator's purse?—Oil-cakes and other indigenous manures can be bought.

52. *Q.* Does it pay to buy them?—Yes, we have made experiments with sugar-cane which prove that certain edible cakes which are not used as manure are more effective than manure cakes in ordinary use and can be bought at cheaper market rates. People do not generally know that these edible cakes are valuable as manure. Oil cakes can easily be broken up into powder for use as manure under the mill stone which is used in every village for making mortar.

53. *Q.* Do you believe that, generally, throughout the country it would pay the cultivators to use oil cakes and other indigenous concentrated manures?—Yes; certainly for irrigated crops.

54. *Q.* Are oil-cakes manufactured largely?—Yes, in every village, the oil is used as food; the cakes are used as food for milk and work cattle locally and are exported also to towns. They can be stored for any ordinary length of time as cattle food.

55. *Q.* There is no want of them in the country?—If there was a large extension of well irrigation, I have no doubt these cakes would get dearer, but we have also *san*, the use of which as green manure could be extended.

56. *Q.* (*Mr. Ibbetson.*)—You mean the yellow pea which we call *sanai* in Northern India? With us *san* is a mallow?—Yes, Mr. Fuller told me that the cultivators in Central India object to grow this crop on account of caste prejudice, but there is nothing of this in the Bombay Presidency. In various parts of the Presidency when the need of manure arises the cultivators save up night-soil.

57. *Q.* (*Mr. Muir-Mackenzie.*)—Would it pay to use oil-cake manure on cotton crops?—No.

58. *Q.* Cotton crops grow well after *san*?—Yes.

59. The practice of using *san* is not common?—No.

60. *Q.* (*The President.*)—Taking all these things into account, what do you think would be the most judicious course for the Government to take to fortify the country against the bad effects of another famine?—I would extend wells in every suitable position, provided it was certain that all the manure required would be available, that all the bullock and manual labour necessary could be commanded, and that the men who owned these wells had sufficient capital on credit to do full justice to the work.

61. *Q.* These are important conditions; I suppose it follows that well irrigation in any tract would never rise to 20 per cent. of the tract?—If it rises to 10 per cent., I should be glad.

62. *Q.* That is the best that can be offered?—In Gujerat on black soil the extension of small tanks for rice would be extremely important. I see that Mr. Mehta thought that they could not be extended in Broach because of the difficulty of labour. I think if the occasion arose that labour would be forthcoming. On the black soil which fringes the Tapti in Khandesh, where linseed, gram, etc., are grown, the question has been solved, as many hill people from the Ghats come down periodically in order to help in the reaping of the crop. I should say that labouring people would be attracted if the work existed.

63. *Q.* (*Mr. Higham.*)—You don't think that the objection to the extension of irrigation without manure would occur?—No, I think the manure will be available in reasonable amounts.

64. *Q.* If canal irrigation is introduced on as large an area as 34,000 acres, will manure be available; you are only speaking of well irrigation?—Yes, I refer particularly to sufficiency of manure for well irrigation and by small tanks. This is the only description of irrigation I recommend for Gujerat.

65. *Q.* The canal irrigation might run ahead of that supply of manure?—Yes, there are other serious drawbacks to that; I anticipate the soil being spoiled by canal irrigation.

66. *Q.* Not in all cases?—No, in the Mutha Canal irrigated tract of the Poona district manure in sufficient amount is available. The effect of canal irrigation has been that a good deal of the land has already gone out of cultivation on account of water-logging. To my knowledge the crops that are produced in that part now are not nearly so good as they were five years ago on account of the land being now surcharged with water. The soil is a medium black soil with *muram*.

67. *Q.* Has not drainage been tried there?—No, there is no combination between the people who occupy the land; one occupant cares little for the interests of another and the canal irrigation is doing a good deal of harm.

68. *Q.* I suppose from your Poona experience; you think canal irrigation should not be contemplated in any part of Gujerat?—Not in any part of the black soil of Gujerat. In the alluvial soils it would be useful if the water is regularly distributed and if manure in sufficient quantity is available I would expect more harm than good by making canals in the black soil part of Ahmadabad. The wells become periodically salt in the talukas west of Ahmadabad. If the proposed Sabarmati Canal passes through these parts salt efflorescence will increase. I have seen a good deal of land which has already gone out of cultivation on account of salt efflorescence in these parts.

69. *Q.* (*The President.*)—It has never been drained?—No, I doubt if it would be possible to drain it. The country is very flat and very wet in the rains.

70. *Q.* (*Mr. Higham.*)—In regard to Broach district which is, I think, all strong black soil, do you consider that rice cultivation in these parts where they have tanks is more profitable than growing cotton and *juari*?—No doubt it is, but then the expenses are more than on dry crops.

71. *Q.* The profits of cultivators on rice would not be greater than growing cotton and *juari*?—They would, I think, be usually greater; the rice crop would be safer provided it got, late in the season, two or three waterings in a year of average rainfall.

72. *Q.* I understand on the whole there is greater chance of the cotton crop failing than there is of rice, if you have proper tanks?—Yes, certainly.

73. *Q.* The tanks make it more secure?—Yes; in Broach and Surat where there is generally too much rain for cotton.

74. *Q.* But not otherwise more profitable to the cultivator?—A good crop of rice irrigated from a tank properly manured is worth Rs. 80 to Rs. 100 per acre; an average crop of cotton is not worth more than Rs. 25 to Rs. 30.

75. *Q.* Do you think Government would be justified in making tanks or in helping in their construction in the district of Broach?—Yes, provided they are small and provided each village controls its own tanks and each community is made responsible for repairs and clearing as required.

76. *Q.* If more than one village controlled a tank what do you fear?—Two villages might perhaps pull well together.

77. *Q.* And in the case of a large tank?—I want to see the people hang together in such a manner that they would absolutely control the water, and that every owner of a rice bed gets a fair share of it.

78. *Q.* There is not much scope for extending tanks in Broach because the country is so flat?—Still you can improve the position by digging out your rice beds; the depth of the soil in Broach is such that you can afford to dig a foot or two and impound rain water; I should say there is very great scope for that in Broach.

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79. *Q.* Would fodder be benefited by irrigation?—Not in ordinary years. In a famine year when fodder is required the cultivator who grows garden crops under a well changes his practice and grows fodder crops instead, because it pays him to do so.

80. *Q.* Ordinarily the cattle here are fed on grass fodder?—Yes, also on *karbi*, straw of all cereals and *bhusa* of pulses; there is a large growth of grass in the Thana forests, the Dhangs of Surat and in the forests of the Tapti Valley, but much of it is so inferior in quality that it does not pay to transport it any distance.

81. *Q.* Where is the good grass sent to?—In Northern Gujerat there are very large areas which produce excellent grass. This grass now, to a large extent, goes to waste because the herds of cattle which grazed these lands are dead and no particular transportation takes place. A small quantity of the grass is taken to Bombay. A great deal more transportation could be done.

82. *Q.* There are ample waste lands for the growth of fodder?—Yes, ample in Northern Gujerat.

83. *Q.* It is not necessary to increase the area?—No.

84. *Q.* What is the amount of fodder that you require to give a pair of bullocks for six months?—A full grown bullock would eat in the course of the day 15 pounds of grass. On that grass alone he would not survive on account of its innutritious nature; there should be an addition of 1½ to 2 pounds of oil-cake; that would be the amount for a full-sized Gujerati bullock.

85. *Q.* That is for a Gujerati bullock; I suppose a smaller bullock would not eat so much?—No.

86. *Q.* What would be the cost of storing the grass, do you suppose, locally?—On the Charodi Farm west of Ahmadabad where we have 600 head of cattle we put up in the year after the famine sufficient to make it certain that there would be about a full year's supply always in hand; that cost us at ordinary rates Re. 1 for 1,300 bundles of cut grass collected in one heap; 1,300 bundles are practically equivalent to 1,000 pounds of grass; cutting, tying and stacking cost us Re. 1. I got two hand presses from the Forest Department, so that we could press this grass into compact bales. I also got wires which had been previously used. The baling cost about Re. 1 per thousand pounds, so that the total cost came to Rs. 2 per thousand pounds. It would be impossible to keep baled grass safely through the ordinary rainfall unless it was protected by corrugated iron sheets. We put up two big Dutch barns using railway rails for supports and corrugated iron for roof. In that way it was very easy to stow away sufficient supply for the cattle on the farm. If it pays to do that on a small scale, it would pay to do it on a large scale. I advocate storage on a large scale in the western talukas of Ahmadabad. Labour is cheap, and if the stuff is kept until the following rains, it could be sold at a profit if the rains are favourable.

87. *Q.* What is the supply at this farm; have you a supply for 12 months?—There is more than a six months' supply.

88. *Q.* Do the people show any disposition to preserve fodder in that way?—No, I have not seen anything of the kind among ordinary agriculturists; they trust to the average outturn from arable lands being sufficient.

89. *Q.* You say this grass goes to waste in Northern Gujerat; is there any market for it?—Yes, a certain amount, but the stuff is so bulky that even in pressed bales it pays the railway better to carry more concentrated stuff.

90. *Q.* Would it pay to send it to Bombay?—Grass is sold in Bombay at from Rs. 10 to Rs. 11 per thousand pounds and that is inferior to what is produced in Gujerat.

(*Mr. Ibbetson.*)—Before commencing my examination, I should like, as one of the Revenue Members of this Commission, to thank you, Mr. Mollison, for your valuable paper; it is, I think, one of the most interesting and informing papers which has yet been laid before us.

91. *Q.* I see you are evidently strongly in favour of small tanks as opposed to large tanks; what is your objection to large tanks?—The water is not so well controlled as it is in small tanks; there is also the risk of salt efflorescence and the risk of land going out of cultivation on account of being water-logged.

92. *Q.* Would that apply to all soils?—It would not apply to soils that absorb water easily; it would not apply to alluvial soils as much as to black soil.

93. *Q.* In alluvial soils would you prefer small tanks?—Yes, if you could get as much irrigation altogether from the small tanks as from a certain number of large tanks.

94. *Q.* The evidence laid before us goes to show that large tanks are superior to small, being more efficient and more certain of a water-supply, and I think that in some ways the water is even more under control on large tanks. Do you think that, if sluices are provided for the distribution of water, the people would be able to distribute the water by means of small tanks with less injury to their own land?—Yes, I think so. I can call to mind one particular tank in the Dharwar district where much damage was done by water-logging.

95. *Q.* On a canal in Northern India that I know very well, exactly the same thing happened; water was given profusely, and we had thousands of acres thrown out of cultivation by water-logging and salt efflorescence. Of late years the canal authorities have restricted the supply of water of each village by giving them pipes of dimensions so calculated as to give just enough water for the land they have to irrigate; that restriction, combined with drainage and the realignment of the canal, has removed the evil of water-logging entirely and is gradually removing the efflorescence. Do you think among these people in Poona a similar restriction of water could be effected?—I should like to see it tried; there is great room for improvement in the distribution of water.

96. *Q.* I understand your fear is that the people would not distribute the water fairly?—Yes; and another difficulty is that the supply in any canal that I know of in the Deccan is not perennial; if there are insufficient October rains, the chances are that water will fail when it is most wanted; if you put on the restriction that you name, it might be that the fields near the canal would get a full supply and others probably would not.

97. *Q.* Would not the effect of restricting the supply materially be to increase the amount of water; that is, to economise the water and so render the supply less liable to fail?—There is no doubt that a great deal of water goes to waste now owing to the intermittent system on which it is given and the beggar-my-neighbour system on which it is taken.

98. *Q.* If you restricted the supply and made them economise the water, would it not last longer?—If you were dealing with a village community that might answer; but in the case I refer to the land has gone out of the hands of the community into the hands of speculators and contractors in Poona; these men sub-let it to others; it is very difficult to make the cultivators co-operate in the same way as in an ordinary village community.

99. *Q.* Setting aside the contractors for the moment, you seem to have doubts whether you can get the people to distribute their water fairly. If you anticipate that difficulty, on what grounds do you advocate small tanks?—Because you are dealing with one village. Each man would take good care to get a fair share; if the same thing could be done with the restricted supply of a canal, you would have the same result as with one tank.

100. *Q.* You think if the restricted supply were given to each village separately, there would be no difficulty?—None.

101. *Q.* My fear is that precisely the same difficulties that you think would arise in the case of large tanks would occur in the case of small tanks?—I don't think so.

102. *Q.* (*Mr. Muir-Mackenzie.*)—Are not the conditions of Poona somewhat peculiar?—Yes, no doubt.

103. *Q.* (*Mr. Ibbetson.*)—What you say applies only to Poona?—Yes.

104. *Q.* It would not apply to, say, a canal near Ahmadabad?—No.

105. *Q.* I don't quite understand your point about irrigation in black soil; true black soil, you say, cannot be irrigated, except for rice. You said you had also tried a mixed soil unsuccessfully at your farm?—There is a description of black soil in the Surat district known as ***Kali Besar*** that can be irrigated with advantage. It has a porous subsoil. On the Government farm we went to very great expense for wells, manure, drainage; the lighter soil is better suited to garden cultivation.

106. *Q.* Is there a description of black soil that can be irrigated with profit?—Yes, in Surat; it is not pure black soil; it is a light back soil and has a porous layer underneath; that combination is suitable for irrigation.

107. *Q.* (*Mr. Muir-Mackenzie.*)—On the farm you have had certain crops which have done very well?—At the same time we have gone to very great expense as regards manure and in the construction of wells.

108. *Q.* (*Mr. Ibbetson.*)—To return to this lighter black soil which is suitable for irrigation and exists in Surat, is

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that found in other parts of Gujerat?—If you exclude the risk of salt, you will find it in the black soil cotton and wheat district of Northern Gujerat; it also exists in the Deccan and Kathiawar. Provided the soil is thick enough, it is suited for tank irrigation from which there is not the same danger of salt as in well irrigation.

109. *Q.* Where that soil exists in Gujerat there is danger of salt?—Yes.

110. *Q.* Is the area under it considerable?—Yes, very considerable.

111. *Q.* Salt would render well irrigation risky?—Yes.

112. *Q.* Now, returning to the subject of the extension of well irrigation, you say you would be very lucky if you got 10 per cent. of the tract irrigated by wells?—Yes.

113. *Q.* Do you mean 10 per cent. of the whole district or of the area suitable for well irrigation?—Probably 90 per cent. of the Deccan is unsuitable for well irrigation; 10 per cent. in a district like Kaira, where the whole tract is suitable for well irrigation, would not be too low.

114. *Q.* Supposing that in Gujerat as a whole you had wells wherever it was advantageous to have them; what portion of Gujerat do you think would be irrigated?—I should not like to commit myself.

115. *Q.* Certainly much less than one-tenth?—Yes, except Kaira.

116. *Q.* In Kaira what would be the maximum that you could irrigate from wells?—I doubt if you could go beyond 10 per cent. on account of the deficiency of the manure.

117. *Q.* You could not have, say, 55 per cent. as in the Punjab?—No, count must be taken of the cost of raising water from deep wells and the need for heavy dressing of manure to make the crops really good and really profitable.

118. *Q.* To take another proposition. Take the *kachcha* wells that were made in the famine; you say that *pakka* wells might be made in place of each of them; suppose Government could make these wells *pakka* by a stroke of the pen, could they at once be used to advantage? Is the manure and labour sufficient?—I should not like to do it in one year. I should like to proceed gradually; the manure and labour would be provided gradually as required.

119. *Q.* The number of wells is steadily increasing in Gujerat year by year; are they not?—I have not the figures, but should imagine there is no doubt of it.

120. *Q.* Do you think the increase in the number of wells is about as great as the increase in manure and of labour would allow of being worked profitably?—No, the increase might be much quicker, but of course there is a limit.

121. *Q.* Do you think there might be a further increase without out-running the supply of manure and of labour?—Yes.

122. *Q.* Do you think Government should build wells?—No, it would be better if the cultivators could be got to do it, making it absolutely certain, that if he means to borrow from Government he will get the whole of the money required.

123. *Q.* The best thing would be to give cultivators all the facilities possible for borrowing?—Yes.

124. *Q.* Can you suggest anything more?—I think it would help materially, if a cultivator constructed a well (it does not matter whether he borrowed the money or builds it out of his own funds), if a premium were put on each acre that is brought under cultivation in the first year, say from October to March, provided that the water got was sweet and therefore suitable for good grains.

125. *Q.* What sort of premium?—I should not hesitate to say Rs. 25 per acre for the first year; that would be about Rs. 200 for a well.

126. *Q.* The well would cost about Rs. 1,000 or 1,500?—Yes.

127. *Q.* Would not that Rs. 200 be thrown away in the case of a man who was going to make a well in any case?—No, he would do more justice to his land and give it more manure, and therefore get good profitable crops at once.

128. *Q.* About small tanks, take the case of the repairs that have to be done annually; I have asked many witnesses, who know the people well, whether they have any hope of getting the people to do these repairs, and the opinion has been overwhelming that practically it is hopeless?—Why?

129. *Q.* Want of combination has been mentioned as one of the reasons?—It could be done more economically by the people.

130. *Q.* I agree that it is the best thing if it is possible but witnesses tell me it is not?—I don't agree with that. I think the repairs should be done by the people. They should be compelled to do them. At the same time there is some risk in clearing out a tank annually; it would hold less water.

131. *Q.* Why should Government go to the expense of repairing these small tanks. Half a dozen men would do the work for themselves?—They have no money; besides they have to pay enhanced land revenue, etc.

132. *Q.* As regards the proposal to store hay, how long would it keep if stored?—An indefinite period if properly baled and protected.

133. *Q.* You say that the market price of hay is never less than Rs. 10 to Rs. 11 per thousand pounds in Bombay?—Yes.

134. *Q.* What would it cost to send it to Bombay?—I believe as regards the Tramway Company that after paying all expenses of baling, etc., in an ordinary year (and they pay for right of cutting grass a good deal more than the Government assessment), it costs them somewhere between Rs. 8 and Rs. 9 per thousand pounds landed in Bombay; that amount includes everything; that was my information three or four years ago.

135. *Q.* You say in paragraph 12 "in the famine year (1899-1900), although the general area under irrigation in the Presidency declined, the well-irrigated area increased by about 100,000 acres." That was because of the *kachcha* wells that were added?—Yes.

136. *Q.* To what extent is that land manured?—The manured area in Kaira and Ahmadabad is about 75,000 acres.

137. *Q* At what season of the year is the manure applied?—You say the manure was to spare from dry cultivation owing to the failure of the rains?—In Gujerat manure is not put into the soil until after the first fall of rain. Tank mud is spread on the surface before the rain, but not farm manure.

138. *Q.* (*Mr. Rajaratna Mdlr.*)—You referred to the difficulty of procuring manure?—I believe I stated that there are possibilities of procuring considerable quantities of manure for any extension of irrigation.

139. *Q.* What are the possibilities?—In certain well-irrigated tracts in the Deccan the necessity for more manure has become evident to the people themselves, and they save up materials which formerly were not used, such as night-soil, household waste, litter and even cattle urine; there are besides other sources of manure that have not yet been fully exploited, such as oil-cakes and green manure.

140. *Q.* Do you think the rayats will be able to solve these difficulties?—Yes. In Poona we began to use manures other than the ordinary. For instance, we used cotton seed as manure for sugar-cane, and the effects were such as to justify the belief that it would pay the ordinary cultivator to use it; we also used certain edible cakes that can be obtained at cheaper rates than castor and *karnaj*; these edible oil-cakes can in some Deccan districts be bought at 70 lbs. per rupee; they are richer in nitrogen, etc., than those usually used; they are not so dear, weight for weight, as the ordinary manure cakes and are more valuable as manure; show the people experimentally that these edible cakes are useful and they will use them. We showed their effect in the district, and the result is that many cultivators use edible cake who formerly used ordinary cake.

141. *Q.* Are leaves of trees used as manure here?—No, except in the Kanara district; but *san* is sometimes ploughed in before planting sugar-cane and other garden crops. (Guvar, a pulse) is similarly used extensively in Gujerat.

142. *Q.* Have leaves been tried in the farms?—No.

143. *Q.* Have you seen the new reservoir constructed at Broach during the famine?—No.

144. *Q.* There is a large extent of land lying fallow in this Presidency in every district; is that reserved for grazing purposes?—Yes, in parts of Broach and Surat ordinary dry crop black soil often lies waste for several years and grows grass. When broken up and cleaned, the crops of *cotton* and *juar* grown subsequently are uncommonly good for several years.

145. *Q.* (*Mr. Muir-Mackenzie.*)—In regard to fallow we find that in the Surat district the area cropped is about 180,000 acres and the fallow land measures about 270,000

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acres. In ordinary years is the latter not more than you would expect ?—What are the figures for Broach ?

(*Mr. Ibbetson.*)—The cropped area of Broach is 564,000 and fallow 90,000 acres.

Witness.—I should expect the real fallow area to be more in Broach than in the Surat district. Grass lands are probably included in both districts, but the area of grass waste in Surat (which is not necessarily unprofitable) is greater than in Broach. A very common practice in the Broach district is to leave certain land fallow. These lands are fallowed and cleaned in a very thorough way and an increased crop of cotton in the following year is obtained.

146. *Q.* (*Mr. Muir-Mackenzie.*)—In Ahmadabad they have checked the figures: 1,178,000 cropped area and 4,04,000 fallow ?—I have no doubt that the fallow area includes a good deal of grass land in Ahmadabad.

147. *Q.* You mean land kept by occupant in his holding under grass ?—Yes, but not necessarily unprofitable.

148. *Q.* In Broach district we have heard of cotton and rice being grown together ?—Yes.

149. *Q.* Are you familiar with this mixed crop ?—It is a practice common in Broach to grow cotton and rice mixed. It is done simply as a safeguard in ordinary years. If the rainfall is moderate, cotton thrives; if the rain is very heavy, there will be a good crop of rice. The rice is grown mixed in the rows of cotton or in an intermediate row by itself.

150. *Q.* If canal irrigation were applied within the cotton area for rice, would a profitable crop of rice be grown ?—No, the rice grown with cotton is a special variety which suits the ordinary dry crop system of cultivation. With canal irrigation rice beds would be necessary and a variety, suitable for transplantation and regular irrigation, would be grown.

151. *Q.* You allude in paragraph 6 of your note to considerable scope for extension of irrigation by wells in the alluvial plains of Gujerat. For what crops do people take water ?—For garden crops in ordinary years; for fodder, *juari* and food-grain crops in a year of scarcity.

152. *Q.* They would not in ordinary years take water for ordinary food crops ?—No.

153. *Q.* Would the difference in yield not be sufficient to pay ?—It might pay expenses, but cost of irrigation is very high and the garden crops pay best.

154. *Q.* In a district near the sea, where the cost of carriage would not be considerable, would imported manure be of any use to extend the manurial supply ?—No, on account of the cost compared with available indigenous supplies.

155. *Q.* When the indigenous supply becomes dearer ?—The occasion has not arisen.

156. *Q.* Mauritius uses large imports of guano, etc., for sugarcane ?—Yes, on account of the scarcity of the indigenous supply. We are in a different position in Bombay. We export bones and oil-cakes. The latter especially would be kept in the country if there was any particular need of manure for extension of irrigated crops.

157. *Q.* Do you think with the available supplies of manure the best crops are grown ?—In India in the best sugarcane districts the value of the crops thus produced probably exceeds that of the best crops in Mauritius. We have in the Poona district time after time produced crops, yielding 12,000 lbs. of *gur* per acre, sometimes worth Rs. 1,000 per acre. In some districts well-irrigated garden crops are often worth Rs. 400 to 600 per acre. These figures indicate that with available supplies of manure, soil and water can be turned to the very best advantage.

158. *Q.* If the supplies of indigenous manures become insufficient and get dear, would the grower of cane and garden crops use imported manures ?—I suppose so, but at present I see no need of importing any description of manure.

159. *Q.* You have grown sugarcane, have you not, with imported manure, on the experimental farms ?—No.

160. *Q.* Not nitrate of soda ?—The crude nitre used is a product of the country.

161. *Q.* Don't you think it advisable to make an experiment ?—I do not see that any practical good would follow.

162. *Q.* Possibly not in this Presidency, but in other parts of India ? —Nowhere in India would imported manures be useful for ordinary agricultural crops at present at the rates at which they can be imported, and I do not expect that they ever will.

163. *Q.* I understood the Honourable Mr. Lely to say that the results from *kachcha* wells were very disappointing ?—That is not my opinion. In the Kaira districts especially I saw numerous *kachcha* wells which gave surprisingly good results.

164. *Q.* The results were not different in different tracts ?—I did not travel extensively through the districts of Northern Gujerat in the famine year, but in the parts I saw the results were good.

165. *Q.* In the tracts that you saw there was no difference ?—No. It would, however, be easier in a district closed in by fences like Kaira for local officers to find out differences of this sort. I can only say that I saw numerous *kachcha* wells and the results were surprisingly good.

166. *Q.* I understand from Mr. Logan, Collector of Broach, that a considerable number of *kachcha* wells dug in the famine were not used this year ?—*Kachcha* wells in the black cotton soil of Broach go out of use in a year, because they fall in. I saw *kachcha* wells in the bed of the Nerbudda in the famine year irrigating *juari*. In ordinary years the chief crops grown under them is tobacco. These Nerbudda *kachcha* wells are dug every year.

167. *Q.* (*Mr. Ibbetson.*)—I understand *kachcha* wells never last beyond the next monsoon ?—*Kachcha* wells in alluvial soil fall in partially at least after the first monsoon rain. A *kachcha* well in the Deccan with trap-rock below may last for years. It is advisable, however, that it should be made *pakka*. In the alluvial soil of Gujerat the labour expended on a *kachcha* well is generally lost if the occupant intends afterwards to make a *pakka* well. The diameter required for a *pakka* well is necessarily greater, and it would be better to excavate for a *pakka* well in a place near the *kachcha* well than to extend the diameter of the *kachcha* well. The labour in digging a *kachcha* well in the Deccan is not lost because the substrata are hard and rocky.

168. *Q.* (*Mr. Muir-Mackenzie.*)—Have the *kachcha* wells of the Deccan, which were dug in the famine, been kept in use ?—I have seen *kachcha* wells dry in the Deccan and therefore not used; but if *kachcha* wells contained sweet water and the soil commanded was suitable for irrigation, I would be surprised if during recent years they were not fully used.

169. *Q.* It would not be advisable to give money for constructing wells to cultivators who were not enterprising ?—No.

170. *Q.* Therefore it would not do very much good to give much money to the backward people in the Panch Mahals ?—No.

171. *Q.* In paragraph 8 you observe that rainfall is usually insufficient for rice. Would you say that it fails as often as two years out of five ?—My experience is that it has certainly done so more frequently than that in the last five years in parts of Gujerat, especially Ahmadabad.

172. *Q.* You say the assessment is a fairly high one. How do you account for the people being able to pay it in spite of its being high ?—The seasons during the last five years were very unusual.

173. *Q.* In ordinary seasons it would fail in two years out of five ?—In those parts of Northern Gujerat where rice is grown and the average rainfall is light, and there is no particular protection from tanks or other source of irrigation, there is certainly a very poor crop or almost total failure of rice two years out of five.

174. *Q.* How do you account for their being able to pay assessment ?—I do not think there is any great difference of assessment between rice fields and dry crop lands in the particular areas I refer to. Dry crops during recent years have been grown in some rice beds and many rice beds lie now waste. The occupants could not possibly have paid assessment out of profits on those rice lands during the last three years.

175. *Q.* I understand you to say that there are plenty of sites likely to be available for small tanks ?—Yes.

176. *Q.* From what have you derived that impression ?—From my general knowledge of the country.

177. *Q.* Do you know this part of the country ?—Perhaps not as well as the Deccan.

178. *Q.* Supposing you have small tanks, how would you proceed ?—By digging rice beds underneath the tanks.

179. *Q.* By digging out rice beds underneath the tanks you would facilitate irrigation by flow, but you would not store the whole drainage from the catchment ?—No; if you

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make the bank too high you will swamp as much land above it as you will irrigate below it.

180. *Q.* Now what would be the effect of this additional supply?—The small tanks would give people the surety of two or three waterings in addition to the ordinary rainfall, and therefore instead of having a very middling precarious crop they would have a good one.

181. *Q.* How would you ascertain the sites of the tanks?—Why not undertake surveys.

182. *Q.* You would like to see surveys undertaken?—Most decidedly as regards tanks.

183. *Q.* Can many more new sites be found?—Yes; and if you put the matter in the hand of a practical man, he could complete his survey probably in one season.

184. *Q.* Would you prefer to extend and improve the existing tanks?—There is room for clearing a great many of them out certainly.

185. *Q.* And enlarging them?—I think that a survey should first be undertaken. It is very difficult to give an opinion on a broad question of this sort.

186. *Q.* Do you think it would be a good thing to encourage the digging of rice beds in black soil by granting *takavi*?—Yes, because with manure, labour and a good position, a very good crop could be grown.

187. *Q.* Do you think it would be a safeguard against the ordinary fluctuations of rainfall?—Yes, I think so. I think that it would be safer than the cotton crop.

188. *Q.* Have you seen the Hansot reclamation scheme?—No.

189. *Q.* They throw a low *bund* round a large area of land; the object is to allow the rain water to sweeten the land?—The same practice is followed on tidal creek land further down the coast to exclude sea water. If the sea water at high tides is excluded, the embanked land is gradually sweetened by the rain.

190. *Q.* We have been told that brackish water is very often usefully used for barley?—And also for wheat.

191. *Q.* The brackish water grows better crops of barley than are grown by sweet water?—Yes, probably.

192. *Q.* That crop can stand brackish water?—Slight brackishness does not hurt wheat or barley, but really brackish water is specially useful for tobacco only.

193. *Q.* A number of questions have been asked as to the number of crops and the number of acres irrigated by a single *kos*. Do you think that a single *kos* would irrigate six acres?—Yes, if the figure applied to successive crops taken in the irrigating season and the water lasts throughout the season. Three crops can be grown in succession on different areas in the alluvial soil of Gujerat; one *kos* will irrigate a greater area of mixed black soil than of *gorad*.

194. *Q.* Do you think famine labour could be employed to advantage in digging *kachcha* wells?—I would rather give an advance of Rs. 25 or Rs. 30 and let the cultivator do the work himself.

195. *Q.* Do you not think a good many famine labourers could be employed at this sort of work?—Yes, probably, but not profitably to the cultivator, because they would not do the work in the particular way he wants it done. If done by himself he would arrange the excavated earth to level his field, to make the slope, and generally to prepare the field for irrigation. He would, moreover, dig the well in the position he knows instinctively would be best for his land, and the people he would employ, his relatives and ordinary servants, would be kept off relief works for the time being.

196. *Q.* Do you think wells constructed by famine labour would be used?—If the occupants of the land dug the wells themselves they would be more likely to be used.

197. *Q.* With reference to the extension of irrigation by *kachcha* wells in Ahmadabad and Kaira in the famine year, do you think Government would be well advised to make all these *kachcha* wells into *pakka* wells?—Yes, gradually, if the occupants cannot be induced to construct the *pakka* wells themselves.

198. *Q.* (*Mr. Ibbetson.*)—If the occupants cannot be induced?—The Government should undertake the construction, but the people themselves can do the work cheaper.

199. *Q.* (*Mr. Muir-Mackenzie.*)—Do you think it would be satisfactory for Government to construct wells?—I should rather see the occupants doing such work themselves.

200. *Q.* Supposing the work of constructing the wells is not proceeding with sufficient rapidity, then you would have the Government step in?—I would prefer to try all possible means to encourage the people to do the work themselves.

201. *Q.* Such wells would be uncommonly useful in ordinary seasons?—Yes.

202. *Q.* There would be considerable extension of irrigated crops?—Yes.

203. *Q.* You say there was no scarcity of manure for well irrigated crops in the famine year in Gujerat. Had not there been a considerable dry crop area sown and the usual application of manure to that area?—*Kharif* areas were sown and manured, but there is also, no doubt, that the irrigated patches got a full supply of manure.

204. *Q.* More than usual?—Yes, because more was available.

205. *Q.* You have not seen much of water-logged areas?—No, except in the central part of Olpad.

206. *Q.* Could these water-logged areas be made suitable for rice by drawing flood water into tanks and growing rice under these tanks?—Your suggestion is, I think, a very good one, and I should like to see the experiment thoroughly tried.

207. *Q.* In paragraph 15 of your note you refer to the land being brought under well irrigation since the Revision Survey in the Khed Taluka?—Yes, I saw a number of new wells being constructed and used soon after Revision Survey which was made 10 years ago.

208. *Q.* Why have they used the wells since the Revision Survey and not before?—They were afraid of enhancement of assessment, especially as regards the well-irrigated areas.

209. *Q.* They did not know that no enhancement was proposed?—I do not think they did; at any rate they apparently adopted the safe course of waiting in order to see what would happen.

210. *Q.* Do not think that they understand it now?—I think they do to some extent.

211. *Q.* Would you prefer permanent exemption of enhancement of assessment on wells or exemption for a term of, say, forty years?—I would prefer permanent exemption in a district well provided with railway and good market communications and where rates are now high.

212. *Q.* Do you think the cultivator, who was offered exemption for forty years, would be deterred from digging a well by fear of subsequent enhancement?—No, I do not think so. I think he would have a good deal of scope to recoup himself and repay any debt he has incurred.

213. *Q.* You say that the removal of a foot or so permanently from the deep soil of Broach improves the position for rice beds and does not lower the fertility of the land. I have been told by the people that the washing away of surface soil by drains spoils the eroded areas?—That is quite likely. The weathering effect of sun on the black soil in the hot weather prepares a favourable seed bed. The drains wash away this favourable seed bed with the first fall of rains. Of course the raw soil then exposed is not a favourable seed bed. I propose the removal of surface soil for rice beds once for all and the favourable weathering action goes on annually afterwards.

214. *Q.* You say there are various reasons why well irrigation cannot be indiscriminately extended; and that it must be restricted to certain areas where suitable subsoil conditions exist. Would you take no steps to ascertain that beforehand?—I would have a survey and put the work in the hands of a practical man who would do a good deal by eye inspection?

215. *Q.* Would you like to see the *data* collected by the Survey Department, especially on points of level and as regards the quality of the water to be made use of?—Such data will help the Surveyor materially.

216. *Q.* How soon would you begin in a famine year to advance *takavi* for *kachcha* wells?—In September or October.

217. *Q.* The second-half of September?—Yes.

218. *Q.* Do you know anything of the experiments conducted by Mr. Tata of Bombay in regard to boring in his Navsari land?—No, I don't, but I do know that borings in several wells in the Surat district resulted in tapping water at a lower level and that the water thus got rose in the wells and increased the supply very considerably.

219. *Q.* Is it necessary to have expensive tools for that purpose; would the country-made tools not do?—That is a question for an Engineer to answer.

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220. *Q.* What happened in the boring trials which recently were tried at the Surat Farm with country-made tools?—In one well the results were very satisfactory; in another smaller well the trial was unsuccessful. A layer of sand was met with, and it was found impossible to screw the borer through this sand. With better apparatus the trial would probably have been successful. I do not know whether better apparatus could locally be made or not.

221. *Q.* You had a considerable amount of success with your imperfect apparatus?—Yes, certainly.

222. *Q.* Do you think it is possible to educate people in the storage of manure particularly in the conserving of urine?—They do not know much about it now; but if the necessity arose for manuring an irrigated crop, the necessary amount of manure will be forthcoming.

223. *Q.* They save urine?—To a certain extent, but the floors of cattle sheds are not likely to be generally *pakka* floored and drained, and this is the only way to save all urine.

224. *Q.* In the famine of 1899 there was a terrible fodder famine and no grass was previously stored; do you think it is advisable to employ famine labour in storing grass?—I suggested that course to the Commissioner, Northern Division, and to the Collector of Ahmadabad, but nothing was done. If the work had been undertaken the grass, which was available in large quantities, could easily have been sold at a profit in Bombay.

225. *Q.* Is grass stored to any extent anywhere in the Presidency?—Nowhere that I know of except in Bombay and in Military Cantonments and by contractors, and such stacks are often purposely burnt to raise prices.

226. *Q.* Would the leading of a canal into tracts, not altogether favourable for wet irrigation, be of value in sweetening the wells and increasing the amount of water-supply in the wells?—Yes; the water level in the existing wells in the Poona district is much higher than it used to be, but this is an accompaniment to waste of canal water and water-logging on low-lying areas.

227. *Q.* Have you found that the tanks have the effect of sweetening the water of wells in their vicinity?—I have not observed it.

228. *Q.* I find you estimate the average yield of the wheat in Ahmadabad to be 1,800 lbs. per acre for irrigated land and 560 lbs. from unirrigated?—Yes.

229. *Q.* Would the irrigated crop get more manure than the unirrigated?—Unirrigated crops get no manure at all practically.

230. *Q.* It is used more extensively for irrigated than unirrigated crops?—Yes. In Northern Gujerat a well irrigated wheat crop, if well manured, may yield 2,000 to 3,000 lbs. per acre of grain, but there is considerable risk of rust.

231. *Q.* I find that in Ahmadnagar we had in—

1895-1896	65,000 acres irrigated from wells.
1896-1897	126,000 " " "
1897-1900	101,000 " " "

Do you think the 101,000 acres would be kept up?—The area will be kept up and extend with a return to years of normal rainfall. In the last four years the rainfall has been deficient. It is certain that as soon as the wells contain a good supply of water the irrigation will increase.

232. *Q.* In Poona you had in—

1895-1896	65,000 acres irrigated from wells.
1896-1897	81,000 " " "
1898-1899	66,000 " " "
1899-1900	57,200 " " "

Notwithstanding that, you hope that an increased area will be maintained?—Yes.

233. *Q.* Also in Sholapur and Nasik?—Yes.

234. *Q.* The increase in Poona is slight?—Many of the wells in Poona are probably in the canal area, and if there is canal water the people do not use them.

235. *Q.* Take the canal in Poona. You had—

In 1895-1896	31,000 acres irrigated.
" 1896-1897	46,000 "
" 1897-1898	54,000 "
" 1899-1900	31,000 "

How do you account for that?—It is very difficult to answer that question without fully studying it.

236. *Q.* Would you prefer small tanks to large for *goradu* soil, or do you refer to black soil only?—Black soil chiefly.

237. *Q.* Would the present be a very good time for pushing the extension of wells?—No; the people are hard up; they have not yet recovered from the effects of the famine, and I do not think that they have the means to do much themselves. They have no cattle and no money.

238. *Q.* Do you think that the administration should not be discouraged if their efforts are not successful at once?—Gradual efforts for well extension should be made.

239. *Q.* Do you think people would be likely to be encouraged if Government advanced money to dig wells and charged a *bagayat* assessment instead of taking back the advance?—When cultivators apply for *takavi* they are not certain that they will get all the money asked for.

240. *Q.* What do you mean?—They are not sure that the advance will reach them. They are not sure that if Government advanced them Rs. 100 they will get the whole amount. Then they are not sure of getting the money in time.

241. *Q.* They might apply quickly?—There are objections to taking *takavi*; the people may prefer to pay heavier interest elsewhere if they do not actually get the whole sum from Government. The current belief is that a good deal "sticks" in the hands of the subordinate service.

242. *Q.* I suggest *bagayat* assessment of Rs. 5 or Rs. 10 per acre as extra assessment for the well, instead of repayment of principal and interest for *takavi*?—I would prefer the payment of interest and refund of advance during a long term of years.

243. *Q.* Why?—Because in that case the people know precisely where they are, and can calculate definitely whether it will pay them to take the money or not.

244. *Q.* If you take a single well it would pay so much for area irrigated by one *kos*?—There is speculation about it.

245. *Q.* Where?—I should prefer interest.

246. *Q.* Why?—I want your reasons. They might agree to pay *bagayat* rates calculated on actual advance of money by Government if they were certain of getting the whole of the money.

247. *Q.* They prefer *takavi*?—Yes.

248. *Q.* Do you think they prefer long instalments?—Yes.

249. *Q.* More than twenty years?—No.

250. *Q.* (*Mr. Ibbetson.*)—One more question. Would you tell us whether in the tracts of Gujerat, where there are neither tanks nor wells, the average rice crop is a poor one?—Yes, in the poorer parts, *i.e.*, in the Mehmadabad taluka of Kaira district and in the western villages of Ahmadabad it is decidedly poor.

251. *Q.* Even in those parts where rainfall is more reliable the existence of small tanks would largely increase the average yield?—Unquestionably, if the tanks can give two or three waterings in the season.

252. *Q.* Could you give us any very rough estimate of the average value of the yield without tanks as against the average with tanks. By what proportion would tanks increase the average yield?—Double, at any rate, in the case of a liberally cultivated crop.

253. *Q.* It has been suggested to us that it does not increase it by more than 14 to 10. Do you think that estimate is incorrect?—Certainly; manure and two or three waterings at the end of the season would double the outturn in my opinion.

Mr. A. C Logan.

Mr. A. C. LOGAN, Collector of Broach.

(*Surat, 11th December 1901.*)

1. *Q.* (*The President.*)—You are Collector of Broach?—Yes.

2. *Q.* What general measures do you consider to be the best to enable Broach to resist famine?—I do not think there is any measure of irrigation which would do any good, because there is no scope for irrigation. We could not possibly get water.

3. *Q.* There are wells, I suppose?—Yes, but the water-supply is limited, and they would be of very little use.

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4. *Q.* The depth is beyond 30 feet?—Below thirty feet the water is salt; you can get a limited supply of sweet water, but directly you increase the supply you spoil the water.

5. *Q.* Is that invariably so?—Almost invariably. Perhaps there may be small tracts where you get sweet water at a considerable depth, but I should say it is true for ⅘ths of the district.

6. *Q.* During the last famine when did the wells give out?—I was not in Broach during the last famine. Practically there is little irrigation from wells in Broach. All the wells give out about the beginning of the dry weather.

7. *Q.* The last famine was very intense and very long; was there any difficulty about drinking water?—As far as I could learn there was no practical difficulty about drinking water during the whole of the famine. There is always a slight scarcity of drinking water in the dry season, but I doubt if it was very much worse during the famine year.

8. *Q.* We have had evidence that there was a stimulus for the time being given to well irrigation by the construction of *kachcha* wells?—It made no really material difference. There were many hundreds of *kachcha* wells, but these were dug only for temporary use.

9. *Q.* Did they not lighten the stress?—They made no material difference. I doubt if 1,000 wells were dug and that would only mean about 1,000 acres.

10. *Q.* You don't see any prospect of improving the means of irrigation?—Of all the districts in the Presidency, Broach is the one which least requires artificial irrigation, because, with 17 inches of rain, good crops can be raised.

11. *Q.* You have had only one famine since you can remember?—Yes, only one within the memory of man; in 1899 we had only 12 inches of rain and the monsoon ceased. During the last two years there may have been famine in other parts of Gujerat, but there has been no distress in Broach which would be thought anything of, if there had not been a famine the year before. This year with 22 inches of rain we should have had a 16-anna crop in a greater part of the district but for damage done by rats.

12. *Q.* Famine has occurred once and so it may occur again?—Looking up at the statistics of rainfall there seems to be no ground for the popular idea that the rainfall has diminished. The figures show that the present rainfall is better than before.

13. *Q.* Three years ago you had famine?—Yes.

14. *Q.* It may come again?—Yes, it may of course; but looking at the averages, there seems to be no reason to fear that famine will occur for another 50 years.

15. *Q.* Have you any water-logged parts in your district and are they increasing?—No, I should not think that they are increasing. Certain areas were water-logged, but we have drained them. There is a water-logged area still in Ankleshvar, but I have no reason to believe that it is materially increasing.

16. *Q.* Is there any question of remitting revenue on account of it, or of reducing the amount?—There is a letter from the Government on the subject.

17. *Q.* Do you know of any good done by drainage?—The people were pleased with the drains for the first two or three years, as they could grow cotton instead of wheat. They are now complaining that they wash away the surface soil.

18. *Q.* Have you had occasion to go into these complaints?—No, I have not had time to look at the lands myself. I have only just joined the district since this question cropped up.

19. *Q.* The Mamlatdar made personal inquiry and his report has been sent to Mr. Beale?—Yes, that refers to the complaints made by the people that the channels had done great injury.

20. *Q.* Has the report gone to the Public Works Department for consideration?—Yes.

21. *Q.* (*Mr. Ibbetson.*)—Is it included in Mr. Beale's report?

22. *Q.* (*Mr. Muir-Mackenzie.*)—Yes; (to the witness) —Do you consider that the report can be relied on?—Yes, I think so. I reported that in Wagra people said that the land had been spoiled, but that elsewhere there was not the same complaint.

23. *Q.* (*The President.*)—I suppose that water-logged tracts have done best during the last 2 or 3 years?—There is no doubt of that.

24. *Q.* (*Mr. Higham.*)—Could you tell me how many wells were constructed in Jambusar?—One hundred and sixteen.

25. *Q.* Are they *kachcha* wells?—Yes.

26. *Q.* The majority of these 116 wells were left incomplete?—Yes.

27. *Q.* How are they dug?—The people excavate a short way down, and when they get sufficient water they leave the well in that state.

28. *Q.* The Mamlatdar who came here just now said in reply to a question that they were all *pakka* wells?—I suppose he called them *pakka* because they cost Rs. 300. He may have called them *pakka*, but they were very poor *pakka* wells; they have no steining or very little.

29. *Q.* Were advances given for them?—Yes, *takavi* was given.

30. *Q.* (*The President.*)—I see Rs. 38,730 was given? —Yes, that was the *takavi* advanced for the 116 wells.

31. *Q.* That is Rs. 334 a piece?—Yes.

32. *Q.* (*Mr. Higham.*)—They irrigated 2,000 acres?—They did.

33. *Q.* Whether they were *pakka* or *kachcha*?—Yes, only in that year; they were used only in the famine; no one had made any use of them since.

34. *Q.* Will they not be used in another famine?—They will all be filled by then. This year our rainfall was fifteen inches below the average, and still they did not use these wells.

35. *Q.* Could you not insist on their completing them, having given them *takavi* for the purpose?—It is generally found that the man has spent all the money he was given and he would again apply for more money; we cannot so control the expenses as to be certain that he has spent all the money on the well.

36. *Q.* He usually spends it on something else?—Yes, very largely.

37. *Q.* Do you know any of these reclamation works made in Hansot?—No; but elsewhere private reclamation works were undertaken, but none of them succeeded.

38. *Q.* I suppose it is only a matter of time?—We gave the people 20 years to reclaim the land; but the land is not reclaimed except partially, not enough to pay the cost; now they say it is not reclaimable.

39. *Q.* You are speaking of the reclamation scheme of some years ago?—I am speaking of the reclamation of salt lands.

40. *Q.* I was referring to the works made during the famine?—I have not got any personal acquaintance with those works.

41. *Q.* You don't know how they worked?—No; but my impression is that you cannot reclaim salt land in under 30 years.

42. *Q.* It is a waste of money trying to reclaim these lands?—Yes; in the Wagra Taluka reclamations were attempted and enormous sums of money spent on them and yet the reclamations have not paid. In some cases the people have been absolutely ruined to my knowledge.

43. *Q.* It may not pay profit from a speculative point of view, but is it worth employing relief labour on?—No, I should not think so.

44. *Q.* Would you employ famine labour on tanks?—No.

45. *Q.* (*Mr. Ibbetson.*)—You doubt whether the work will be profitable?—Yes. Nobody is satisfied with any of the tanks dug in my district by famine labour. The large tank which you saw is of little good for irrigation and is not required for the supply of the city, which was already supplied with water.

46. *Q.* Four or five very large tanks would be of no value?—I could not say until I had seen them.

47. *Q.* (*Mr. Higham.*)—What else would you suggest for your famine labour?—Employment of good roads, which are the great want of the district.

48. *Q.* Where will you get your metal from?—The metal would have to be brought from outside, as we have not got metal in the district.

49. *Q.* Would you use famine labour to make the banks?—Yes.

50. *Q.* Must the roads be metalled?—Yes, if they are intended to last any length of time.

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51. *Q.* Work of that sort like railways employs very little labour in proportion to its cost?—Yes, but we should have something to show for our money.

52. *Q.* (*Mr. Ibbetson.*)—Do you think you would be able to keep up these metal roads, supposing you made them in the famine?—Yes, the Local Board could do it.

53. *Q.* They would have to import metal?—Yes. We have made many roads and keep them in repair; the cost of making a new road is about Rs. 10,000 a mile. The Board now does a few miles every year besides repairs. If Government provided the capital cost, the Board could spend on repairs the money which it now spends on new works.

54. *Q.* Do you expect Government to pay for the famine labour and to give you the metal free?—It would be just as good as spending money on useless tanks.

55. *Q.* Not on useless tanks but on feeding a starving people. You propose to employ the labour on the earthwork of roads and to spend twice as much in importing road metal?—There must be some increased expenditure involved to Government. The Government would have to bear all the expenses, the Local Boards could not, especially in a famine year.

56. *Q.* I find in your note no expression of opinion about tank irrigation; you have strong reasons against trusting to well irrigation. Would you do anything to extend tank irrigation?—I do not think tank irrigation is irrigation at all, looking on irrigation as protection against famine; for when the rains fail the tanks fail.

57. *Q.* But does not the increased yield put the cultivator into a better position to resist famine, and thus there is less likelihood of his coming on relief?—That is so.

58. *Q.* I suppose tank irrigation is profitable to the people?—Yes, for rice.

59. *Q.* Do you think relief labour could be usefully employed in cleaning out the tanks?—I would have said that tanks are a useful form of relief until 3 or 4 months ago, but I now see cause to doubt it. Wherever I go people tell me that tanks are none the better for being cleaned.

60. *Q.* Do they give any reason for that?—The old bottom is disturbed.

61. *Q.* Do they ever ask for new tanks?—They ask for the excavation of village tanks which are used for irrigation and for cattle.

62. *Q.* Would you deepen the village tanks?—I doubt the useful effect of spending money in deepening village tanks; the soil has cracks, so that the more we deepen the tanks the more the water disappears.

63. *Q.* Do you think it is worth while doing anything to extend irrigation in Broach?—I think Broach district does not require any extensive scheme. The people are exceedingly shrewd, and good cultivators would dig wells no doubt; if they thought wells of any use they would dig them and they can get *takavi* for the purpose. My experience is that they won't dig wells even if you gave them the money free; if they did dig they would not use them, as it does not pay to draw the water.

64. *Q.* The unirrigated crop is so good?—Yes.

65. *Q.* Suppose you had another famine next year and relief labourers to be employed somehow, do you think you could do any good to the district by employing them on irrigation works of any sort?—No, I should employ them, in the first instance, in digging out village tanks; the area for irrigation tanks is very restricted; it would be simply throwing away money to dig irrigation tanks in black cotton soil, where people are quite satisfied with getting their cotton. They don't want irrigation there.

66. *Q.* They would not substitute rice for cotton?—I think on the whole that they would not.

67. *Q.* They prefer cotton?—Yes.

68. *Q.* Apart from the question of assessment?—Yes, it is a very hardy crop and a profitable one.

69. *Q.* (*The President.*)—Has the question of employing famine labour to make navigation canals in Broach been considered?—Never to my knowledge.

70. *Q.* (*Mr. Rajaratna Mdlr.*)—There are several tanks in the district?—Yes.

71. *Q.* Do you think it would be possible to increase their capacity by raising the *bunds*; you object to digging and disturbing the soil?—I could not give a professional opinion on that subject, as I am not an Engineer.

72. *Q.* Is it not generally known that their capacity deteriorates owing to neglect to repair them. Could not famine labour be usefully employed in that way?—Yes, if the Engineers certify that the raised *bunds* would increase the capacity of the tanks.

73. *Q.* (*Mr. Muir-Mackenzie.*)—In some parts of your district there are considerable areas of waste water-logged lands?—No, not a very large area.

74. *Q.* An appreciable area?—Yes, but except in Ankleshvar they are mostly all drained.

75. *Q.* Do you think that drainage is the best remedy for them?—I do not know any other remedy. It is rather a dangerous thing to do unless it is done very carefully. You may take away more water that you ought to. I saw the drainage scheme that was first started in 1885; it was founded on the basis of draining off 5 inches of rainfall per day.

76. *Q.* It is only one inch here in Olpad?—I am referring to the report of Mr. Day; he says he found that the heaviest rainfall on any one day was 11 inches, so he prepared a channel to carry off rainfall in 2 days.

77. *Q.* Would it be any use running drains into tanks in water-logged areas with a view to create rice cultivation?—I think it is the best thing to drain into tanks below the drains.

78. *Q.* If you put regulators in the drains you might, to some extent, obviate the danger of taking off too much water?—That is a question for the Engineers to answer.

79. *Q.* Was famine labour employed on these reclamations you spoke of?—No, it was private enterprise.

80. *Q.* (*Mr. Ibbetson.*)—You say reclamations might take 30 years; but will they succeed in the end?—Of two men who undertook extensive reclamations, one is stone broke. The other has large means and got a good deal of fertile land in conjunction with his reclamation. He won't tell me he has succeeded, for next year the Government assessment falls due, but I think he will stick to his reclamation.

81. *Q.* (*Mr. Muir-Mackenzie.*)—Do you think the terms of granting *takavi* are sufficiently liberal?—Yes, I don't think the rayats ought to be given money at a lower rate of interest than we have to pay.

82. *Q.* Could any further simplicity be introduced in the procedure of granting advances?—I believe that during the last two or three years *takavi* has been given with remarkable simplicity.

83. *Q.* But in ordinary years?—Inquiries must be made; first of all you must know the man's position, whether he is solvent. We ask the Mamlatdars to make inquiries.

84. *Q.* Do you think they are a bit slow?—Yes, in ordinary times, they are; but they have not been slow during the last three years.

85. *Q.* Do you believe that there is misapprehension and unfounded fear on the part of the people that if they make wells either out of their own resources or out of *takavi* advances they will be charged enhanced assessment contrary to the law?—Yes, they fear enhanced assessment if the well is made in their own land.

86. *Q.* They would be afraid of something more than if they left the land dry?—Yes; it is reasonable, as nobody knows to the contrary.

87. *Q.* It is in the law (reads from the Code, Section 107)?—At any rate the general feeling is that Government is inclined to assess improvements at every new revision. This morning I travelled along with a wealthy Parsee gentleman who said his assessment had been enhanced 1,200 times in the Revision Survey owing to his having improved his land.

88. *Q.* Do you believe him?—I don't believe him so far as the 1,200 times are concerned.

89. *Q.* You don't think the provisions of the Code are understood by the people?—No, I don't; but I may add that I think that when it pays they will make wells regardless of enhancement.

90. *Q.* Do you think, given tank irrigation, rice crops would be more profitable than cotton?—I do not think so; the people would never change cotton for rice. The people are very lazy. If an enterprising cultivator uses a good deal of manure with irrigation, I think that a rice crop might be more profitable than a cotton crop, but I am doubtful. There is so little rice in the district that I have never made a comparison of the profits. Cotton gives from Rs. 30 to Rs. 40 per acre.

Mr. A. C. Loogan.

91. *Q. Mr. Mollison* said it might give Rs. 100?—I doubt that except in very exceptional land. The people like growing cotton, because it gives them very little trouble.

92. *Q.* My point is this, if famine relief labour is employed upon digging rice lands, it might help the people to grow a more profitable crop?—I am not sure how far it is a more profitable crop. I have not studied the question. I am very doubtful whether, if rice tanks were made all over the place, the people would change their cultivation in black soil.

93. *Q.* Are you aware that rice is grown with cotton. The cotton is intermixed with rice?—Yes.

94. *Q.* I understand from Mr. Mollison that in the year of excessive rainfall the cotton may fail and rice would succeed?—Yes.

95. *Q.* Under these circumstances would it not be possible to grow rice and make it a safer crop?—They have adopted rice in certain areas where there is a heavier rainfall or when they get surface drainage collected.

96. *Q.* You don't agree that the Nerbudda and Tapti would offer splendid opportunities for irrigating large areas of very valuable crops in the Broach district?—No.

97. *Q.* It is said that during the last 30 years there has seldom been a year of good rains. The rainfall returns contradict it. In former times the people used to say that Broach could not have a famine, because they could set a cotton crop with 17 inches?—I don't agree.

98. *Q.* We were told by an Assistant Engineer that the population in Broach was without occupation for seven months in the year?—They are fully occupied from June to March or for ten months in the year; our difficulty generally is the deficiency of labourers.

(*The President.*)—We were rather astonished at what fell from that gentleman.

Mr. M. Visvesvaraya, A.M.I.C.E., Executive Engineer for Irrigation, Poona.

(*Poona, 20th December 1901.*)

Mr. M. Visvesvaraya

1. *Q.* (*The President.*)—You are the Executive Engineer for Irrigation, Poona?—Yes.

2. *Q.* How long have you held that position?—For two years and eight months.

3. *Q.* Where were you previous to that?—I was attached to the office of the Superintending Engineer, Central Division.

4. *Q.* What are your duties here?—I have charge of the Mutha and Nira Canals, including their storage reservoirs, four small tanks, two or three famine works, and the water-supply of Poona and Kirkee Cantonments.

5. *Q.* You say—"The cultivable area commanded by the works is 289,981 acres, or about 12 per cent. of the total cultivable area of the district. There is room for further extension, especially in the northern half of the district." How much do you estimate of the cultivable area is actually cultivated every year?—Nearly the whole area is cultivated; the cultivation by means of irrigation is, however, only about 60,000 acres. The rest is on rainfall.

6. *Q.* You say there is room for further extension, especially in the northern half of the district; what extension do you contemplate?—There are a number of small rivers on which reservoirs may be built. In the north-eastern portion of the district irrigation might be practised from storage reservoirs, constructed near the *ghâts*. The whole area would want a systematic examination.

7. *Q.* With reference to what you say about there being room for further extension, is that from personal knowledge?—No, not entirely; that is my general impression formed in my tours in the northern part of the district. No surveys have been made except a very long time ago; probably about 25 years ago.

8. *Q.* You say in your note—"The reason of more favourable results in this district is that large storage works, which have an unfailing *ghât* supply, have been constructed in combination with canals which reach down to tracts of scanty or uncertain rainfall." You refer here to the Kharakwasla?—Yes, and the Nira Canal also.

9. *Q.* Do you know whether in this district any other surveys have been made?—We have recently made surveys in the river valleys in four places. Mr. Beale has the results of the preliminary surveys. We have prepared rough estimates for works costing about 60 lakhs of rupees.

10. *Q.* What manner of works are these?—Three out of the four are works of a productive nature; that is, they would be worked for growing high-class crops.

11. *Q.* Do they depend on reservoirs?—Yes.

12. *Q.* Where are they?—On the Pauna and the Mutha rivers in the *ghât* region and the Kara river on the plains.

13. *Q.* These projects are to strengthen the Mutha Canal?—Partly; two of them are intended for that purpose.

14. *Q.* What is the discharge on the Mutha Canal?—It is not more than 250 cubic feet per second; we propose to increase it to about 500 cubic feet per second.

15. *Q.* What is the discharge from the Nira?—About 450 cubic feet per second; we propose to increase it to over 700.

16. *Q.* Then you have not a general scheme for the whole district?—No; there is a lot to be surveyed before a general scheme can be formulated.

17. *Q.* Do you find the people on the Nira Canal ready to take water always?—They are ready now. Before 1898 there was more water than there was demand for. That was due to sufficiency of rainfall; we may be returning to the same state of things again. If there is a good rainfall, there will not be much demand for dry crop irrigation. On the Mutha Canal we have no water to give for *rabi* crops.

18. *Q.* If there is good rainfall, say up to the end of September, then you would start the *rabi* crops?—Yes.

19. *Q.* Without irrigation?—They almost always sow on rain, except in a year of drought. They wait for rain. If the rainfall is insufficient, they ask for canal water. In one year out of three they get enough rain for a fair *juar* crop.

20. *Q.* When?—From September to November.

21. *Q.* (*Mr. Muir-Mackenzie.*)—Is it necessary to get the November rains in order to get a good crop?—Yes, or at least at the end of October. If the later rain fails, they require water from the canal.

22. *Q.* Without the water could they not get any crop?—That depends on the character of the rainfall. If the quantity or distribution of rain be insufficient or unsatisfactory, the crop will be very inferior.

23. *Q.* In a good year you would reckon on the October rainfall?—Yes.

24. *Q.* The later the rainfall the better the crop?—Early rain is also necessary for sowing. If the late rains fail, they always use canal water.

25. *Q.* (*The President.*)—You say—"Where there is chronic deficiency of rainfall there is demand for water every year on black soil also?"—Yes, in the eastern parts of this district.

26. *Q.* Do you mean even in ordinary years?—Yes; under the small tanks in the eastern or dry parts of this district, there is a demand for water in the *rabi* season every year.

27. *Q.* Although it is black soil?—Yes, if they get good rain they prefer to raise the crops on rainfall; otherwise they fall back on the canal.

28. *Q.* You say it is no disadvantage to have black soil where the water-supply is perennial; you mean for sugarcane?—Yes, and even for dry crops in the drier tracts.

29. *Q.* Do they grow sugarcane freely?—Yes, but the black soil wants a lot of manure.

30. *Q.* You say—"The rivers and streams in the northern part of the district are suited for extension of irrigation to that region." You know the soil in the northern part?—Yes; it is lighter than in the south.

31. *Q.* Therefore it will take irrigation more freely?—Yes.

32. *Q.* Is there any proposal for a survey?—A long time ago surveys were made, but when they took up the Nira, they probably thought they had done enough for the district.

33. *Q.* There are no Provincial Works?—No. None.

34. *Q.* Have the villagers never been in the habit of making irrigation tanks?—Not in recent years.

35. *Q.* There are no ruins of old tanks?—There are some small tanks used for water-supply or washing by men and cattle.

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36. *Q.* In some parts of the Bombay Presidency there are tanks in every village?—That is not the case here.

37. *Q.* (*Mr. Muir-Mackenzie.*)—Have you served in Gujerat?—Yes. I was in Surat.

38. *Q.* (*The President.*)—Comparing the soil here and in Gujerat, I suppose there is more black soil there than here?—Yes, but the soil here does not crack as in Gujerat.

39. *Q* Do you know anything of the Tapti valley scheme?—I have heard of it. I think a scheme of that magnitude should be given a trial notwithstanding the black soil. No chance has been given for such works in Gujerat yet on a large scale. I do not see why we should not construct a large canal.

40. *Q.* You say—"Inquiries show that during the drought of 1899-1901 the water-supply of wells ran short. Do you know how long it took to run short; did it begin to break down in the first dry year?—I think it first broke down at the end of 1899 or beginning of 1900. I was not here in 1896; 1897 and 1898 were fairly good years.

41. *Q.* Have you ever thought as to whether it was necessary to require applications to be made every year for water? Is it not a discouragement to the cultivator to go through all the necessary formalities?—In the case of the small tanks I think water applications should be dispensed with; on large canals this cannot be done. In the monsoon we stretch a point and allow cultivators to take water. There is a Government Resolution which permits the watering of dry crop in the monsoon before accepting water applications.

42. *Q.* Is there any use in the application system?—It is of great use after the monsoon, for dry weather and perennial crops, when the water-supply is limited.

43. *Q.* What advantage do you attach to it?—It prevents our accepting responsibility for watering a larger area than there is water for. We have to calculate for what area we can give water. We cannot promise an indefinite amount. We usually determine the supply available in November after the monsoon and we find out for what area we can give water and restrict the applications accordingly. At the end of the monsoon we have a certain amount of storage in the tanks which can irrigate a certain limited area only. If everybody were allowed to take water, the water-supply would run out in the middle of the season and the crops would suffer.

44. *Q.* What are you afraid of if you give up the system?—For instance, on the Mutha Canal we have about 3,000 million cubic feet of water ordinarily. The storage varies. If the later monsoon rains fail, wholly or partly, this storage is drawn upon earlier in the season, and there is the further disadvantage that the normal flow in the river stops earlier than in seasons of good rainfall. In a good year, therefore, the water-supply may suffice for 30 to 40 per cent. larger area than after an unsatisfactory monsoon.

45. *Q.* Does the supply vary very largely?—Yes, to the extent mentioned already; we raise the water above crest level by means of temporary standards and boards. That makes a difference of about 600 million cubic feet.

46. *Q.* In a year of drought you cannot depend upon having the Mutha reservoir full?—No, not to the top of the temporary weir crest. We store water at the end of the monsoon 2 to 4 feet above the crest of the waste weir by means of a temporary weir of standards and planks; whether the tank fills to the top level of the planks or not depends on the later monsoon rains. This also introduces an element of uncertainty in regard to the quantity of water available.

47. *Q.* Do you think that, generally speaking, you would get the full supply or not?—We are certain of the lake filling every year up to the top of masonry crest.

48. *Q.* Then when you begin the *rabi* irrigation in October and November you should be able to count upon a certain amount of water?—The difficulty is that if the later monsoon rains fail, there is no water in the river to speak of and we have to draw upon the storage earlier. We cannot be certain what storage will be available till about the beginning of December; that is our great difficulty. We have tried to work this out scientifically for the past two or three years. If we had failed to do this, there might have been extensive failures of crops by untimely failure of supply.

49. *Q.* Between what limits can you count?—The difference will be 20 to 25 per cent. between short and full storage; we cannot put up the planks early enough to make sure of a full tank, because there is danger of heavy floods over-topping the plank weir and raising the storage to an unsafe level. If, on the other hand, the planks are put in late and the later rains fail there may be no replenishment in that season. These circumstances render the storage uncertain within the limits stated.

50. *Q.* The remedy is, I suppose, a supplementary reservoir?—Yes.

51. *Q.* If you had that supplementary reservoir, could you count upon a fairly uniform discharge?—The uncertain conditions in that case will go lower down. Now up to Loni we have got a fairly satisfactory supply throughout the year; and if we build another reservoir, the limit will be shifted 12 miles further down, and beyond that limit the uncertainty will continue. The fact is we want very much larger storage than we have at present.

52. *Q.* Are you aware that on the great canal systems of Northern India no applications are ever asked for?—The villagers send up applications on the Sone Canals.

53. *Q.* I am talking of the Punjab and North-Western Provinces?—I am not aware of the conditions there.

54. *Q.* The village gets a certain number of sluices and the people work them; they distribute the water and there are no applications?—We cannot do that here; our water is too valuable except in the monsoons when the rivers are full. Our storage at other times is very expensive.

55. *Q.* You say in your note—"Irrigation works get no credit for increase of land revenue." Is that the case?—Yes.

56. *Q.* Is not an owner's rate charged on land?—Not in the Bombay Presidency.

57. *Q.* There is a book credit given to the canal; is there not?—Not on the new capital account works.

(*Mr. Muir-Mackenzie.*)—The land is not assessed wet on Government irrigation works. The water-rate is kept quite distinct from the land revenue. In theory the canal gets all the credit it deserves, though in practice it may not get all. There may be some enhancement made owing to the increased security.

58. *Q.* (*The President.*)—Then the canal does not get full credit for what it does for the country?—It does not.

59. *Q.* (*Mr. Ibbetson.*)—Does not the introduction of a canal bring new land under cultivation?—(*Mr. Muir-Mackenzie.*)—No, only the cultivation of old land is rendered more secure. There is only one per cent. waste even where there is no canal. If credit were given, I think it would only increase book complications without any material addition of revenue to the canal.

Witness.—Neither could we guarantee the water-supply every year for irrigating the whole area now classed as irrigable.

60. *Q.* (*The President.*)—If you have sufficient storage reservoirs?—In that case we can guarantee to the extent of the storage only; it depends again on the nature of the crops.

The President.—It seems very important for the Bombay Presidency that all credit should be given to canals.

Mr. Muir-Mackenzie.—It would complicate accounts without, I think, much advantage to the canals.

Witness.—(Continuing) You say we might give water permanently without applications; what rate would you fix?—(*The President.*)—Rs. 3 an acre for wheat.

Witness.—Our working expenses amount to about Rs. 3-8, so it would not pay if the crop rate was only Rs. 3 per acre. We have a net revenue now of over Rs. 3,50,000.

61. *Q.* I don't quite understand your point?—The more you extend irrigation the more you lose; our revenue depends on the nature of crops more than on the area. A large extension of low-rated crops is a disadvantage from the point of view of revenue.

62. *Q.* I don't yet see your point?—Would you charge by the quantity of water or the area irrigated?

63. *Q.* By the area?—There would be the difference of Rs. 2 and Rs. 40 per acre that I spoke of.

64. *Q.* Would you say to a man if he asked for irrigation for a dry crop, I cannot give you water because there is so much required for sugarcane?—The water-supply is hypothecated for a certain area and only the balance is available. If every one were allowed to take water as he chose, the supply would run short. In Northern India they admit as much water into the canal as they can and they prefer wasting it down the canal where there is a chance of some of it being used to allowing it to run to waste in the river itself; here in Bombay we try to draw from our storage

reservoirs as little as would just meet our wants because the water-supply saved is reserved for future use.

65. *Q.* In Northern India it is true that the rivers have a large discharge, but it varies and the supply in the canal is often insufficient?—There, I think, more than three-quarters is dry crop; here we have to regulate the amounts; one million cubic feet will grow 1½ to 2 acres of sugarcane; for the *rabi* crops it will be 12 to 15 acres.

66. *Q.* Do the people that are growing sugarcane have to send in applications?—Yes; the sowings begin in February and go on into March and April; we calculate what supply will be available; we only take applications to the extent that we have water for.

67. *Q.* Don't you think it possible to bring down your working expenses?—We cannot in the case of high-rated crops.

68. *Q.* Your working expenses are enormous compared with Northern India?—I don't think so; our crop rates also are very high; compared with the capital cost of the works our charges are moderate.

69. *Q.* (*Mr. Muir-Mackenzie.*)—Our present working expenses are so much disguised by the system of accounts that it is impossible to get at them.

Witness.—Will you please refer to page 12 of my Memorandum about the system of accounts in this Presidency; we can manipulate the area; for instance, we could check the area under sugarcane and increase that on *rabi* crops—one acre of sugarcane is equivalent to about eight acres of *rabi* crops; on the Mutha Canal, by refusing water for cane, we could irrigate 40,000 acres instead of the 8,000 acres at present.

70. *Q.* (*The President.*)—Which is the best way of protecting the country against famine?—I think working on "productive" lines; we should not lock up water on the chance of a famine; we should every year make an estimate of the water available for high class crops, and in famine years make some concession in favour of dry crops; please see page 17, section 9 of my Memorandum. Another point, in this Presidency, is that we have about 300,000 acres, which are estimated to be irrigable, but we only work up to 100,000. In other Presidencies they work almost up to their maximum.

71. *Q.* It comes to this, that in the famines, which do unfortunately occur, Madras and the Punjab can protect themselves, but Bombay cannot on account of the system followed?—I consider that water should not be reserved to a large extent for dry crops in a famine year because it would disorganize the cultivation of high class crops; I had much rather have a fixed area of high class crops from year to year than reserve water for dry crops for which the demand is slack in ordinary years, and only becomes keen in years of drought; my proposals on this point are explained in section 9, page 18 of my Memorandum.

72. *Q.* By 'fixed area' you practically mean sugarcane?—Yes, and garden crops; also a certain proportion of cereals and other crops.

73. *Q.* You begin to irrigate sugarcane in March?—Yes, about February and March.

74. *Q.* If you have a fixed area of sugarcane, you don't know in March if there is going to be an early monsoon, and if the monsoon fails on the 1st of October and the tanks get dry, what would you do?—Our *ghât* reservoirs fill every year. We could only guarantee one-third of the area for which there is water. In ordinary years I would allow people to have cane under wells, but would not guarantee them water after October. That is the "permissible" area.

75. *Q.* Your 'fixed' area would be strictly limited?—Yes, otherwise the water-supply may fail.

76. *Q.* Is your "permissible" area just what is over and above the "fixed"?—I should like to refer you to section 9, page 17 of my Memorandum.

77. *Q.* As regards the "permissible area," if a man were to come and say—I want to start my sugarcane now and am prepared in November and December to go on with my well, would you make him pay less?—Yes, certainly.

78. *Q.* (*Mr. Ibbetson.*)—You say in a famine year you would refuse water to "permissible" cane and keep two-thirds for dry crops, but a man gives in his application in March, and you don't know till August how things will be?—I would accept his application conditionally on the water-supply being liable to be withdrawn if necessary in October.

79. *Q.* Do you restrict the area of sugarcane in a dry year?—Yes; we don't accept applications freely.

Mr. M. Visvesvaraya.

80. *Q.* How do you know in March or April that it is going to be a dry year?—We accept applications in March and we calculate the area for which we want water up to the end of June, and issue passes accordingly. If we tide over the hot weather, we have ample supply in the monsoon. After the monsoon also we usually have sufficient supply for bringing to maturity crops sown in the previous hot weather. If the monsoon rainfall is good and the tanks are full, we may give water to the area which I have classed as "permissible". If the water-supply is short, the permissible area will be refused water and will have to fall back upon wells. The "fixed" area will get water till March following.

81. *Q.* (*The President.*)—Is there much scope for extension of irrigation?—Yes; but each work is judged by its direct productive value, and if this unsatisfactory the Government of India will hesitate to grant funds, no matter how strong the recommendations of the Commission may be. Sound finance is the test of success in irrigation as in every other public department and our first concern should be to show a good return. In order to enable us to show a good return we want to work our system on lines suited to local conditions and not on those laid down for other conditions in the North-Western Provinces and Punjab. Financial considerations are everything.

82. *Q.* We would not be here if financial considerations were everything. Don't you get as much money as you require for the maintenance of canals?—It is stinted.

83. *Q.* Do you mean for construction of new works or maintenance of existing works?—Both (paragraph 3, page 1 of Memorandum read out).

84. *Q.* That is for construction; are you stinted for maintenance?—The reduction in expenses on maintenance began with the abolition of the office of Chief Engineer and special Executive Engineers for Irrigation; from about 1885 the annual outlay, both for maintenance on old works and for new works, has been very low and the tendency has been towards severe economy.

85. *Q.* You have got works which are not paying at all?—My works in this district pay fairly well; they show the best results in the Presidency, because they are large.

86. *Q.* Do you consider that by spending more money you could get a greater return?—Yes, by increasing the scope of the works. For instance, the discharging capacity of the Mutha Canal may be increased from 250 cusecs to 500.

87. *Q.* Would the expenses of maintenance be doubled?—No, they would not be in the same proportion. If we provide more storage and work more on productive than on protective lines will our works pay. The more storage we have the more will our works pay. I guarantee that if I am given a chance to work the Nira Canal on our own lines, we will make it pay the full interest on the capital outlay; but there are two things necessary: we must be given more money and allowed to work on our own lines.

88. *Q.* In what way have you been hitherto restricted?—The tendency of the orders of the Government of India has been in that direction (paragraph 3 of Resolution No. 53-I., dated 9th March 1893, by Government of India, read out as in paragraph 3 of Memorandum).

89. *Q.* (*The President.*)—Does the Government of India restrict you as to the amount you must use for sugarcane?—

Mr. Muir-Mackenzie.—Yes.

Witness.—Yes, and I have to lock up water in expectation of its being utilized for other crops every year.

90. *Q.* (*Mr. Ibbetson.*)—You would look to returns rather than to area?—Yes; good returns are an indication that valuable crops are grown and the locality steadily benefits by the irrigation work.

91. *Q.* (*Mr. Muir-Mackenzie.*)—The Government of India say that certain works are to be productive and certain protective. The Nira is a protective work and we can only give a limited quantity of its water for perennial crops after reserving sufficient to irrigate a reasonably large area under dry crops in a year of drought.

92. *Q.* (*The President.*)—As a result of the system you follow you may have water locked up?—Yes, at the end of the year water may remain unused. If water is reserved for dry crops, it may never be used in that particular season and may be locked up till the next replenishment, or it may be run to waste.

93. *Q.* Simply because it was kept for dry crops?—Mainly because of that; we have never been able to use the

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whole supply for high-class crops, although there was the demand.

94. *Q.* If there were no applications, not a drop would have been wasted, if the people had utilized it, taking all the water they liked?—If there are no applications and no control, the water-supply may run out in March or April; that is, in the middle of the season. We must control every part of the canal and regulate the flow in our canals according to the supply available; the circumstances are entirely different here to those in other provinces. We have a totally different set of conditions and we desire that we may be allowed to manage things in our own way.

95. *Q.* The question is to protect the country against famine?—I should place irrigation in the first line of defence for protecting the country in times of famine, but irrigation cannot entirely protect the country in such years. We must have irrigation works to the utmost extent possible, but at a reasonable outlay.

96. *Q.* You say in paragraph 20, page 5 of your Memorandum, "in good seasons the black soil of the Deccan yields a full harvest and in ordinary years a fair harvest"; I suppose there is great variety in the black soils?—Yes, there is a great variety.

97. *Q.* In some places more than others they take irrigation?—Black cotton soil is the worst for irrigation; it cracks; other classes of black soil which are mixed with sand or have a *muram* sub-stratum are favourable, especially for sugarcane.

98. *Q.* Do you know of what proportion of the Deccan black soil one might say that it cannot be irrigated at all?—A very small proportion. On all kinds of black cotton soil if there is a chance of good rain; it pays the people to raise food crops and cereals on rainfall rather than on canal water. Irrigation from canals can be carried on with profit for growing all crops which cannot grow on rain alone. We found at Ahmadnagar, where the soil is black, they take water, but at Surat and Broach under no circumstances will they take it?—I think that there is more sand in the Ahmadnagar soil. Surat soil is inferior for purposes of irrigation.

99. *Q.* I see you say in paragraph 23, page 5, "during 1895-96 the area irrigated in the Deccan and Gujerat was 74,923 acres and the assessed revenue from water-rates amounted to Rs. 4,52,476. During 1897-98, though the area rose to 126,516 acres, the revenue amounted to Rs. 4,93,139 only, so that with an increase of 69 per cent. in area the increase in revenue was about 9 per cent. only?"—1897-98 was practically a famine year and there was famine in the previous year. People were anxious to replenish their store of grain and there was an extension of dry crop irrigation.

100. *Q.* The Maswad and Ekruk tanks cannot, I suppose, be connected with the *ghâts*?—I think not the Ekruk; an attempt might be made with the Maswad; the question should be investigated.

101. *Q.* You say on page 8 in paragraph 6 "the formalities of the water applications and special measurements, etc., are also obstacles in the way of extensions of irrigation"; you propose the "fixed" area on that ground?—In order to enable us to dispense with water applications by crops, I have proposed "fixed irrigation" under my scheme. I propose to dispense with water applications entirely in the case of small irrigation works only.

102. *Q.* Would the "fixed area" be the same land every year?—It would be the same for six years and would then be changed. Under my scheme one-third of the water-supply will be given to the "fixed area" always; the remaining two-thirds will be given to the "permissible area" in good seasons and be applied to dry crops in seasons of drought.

103. *Q.* If a man held 300 acres, he might without sending in an application grow sugarcane over 100 acres?—Yes, I should restrict the area under sugarcane to one-third of the total area of the blocks.

104. *Q.* He might grow it on any hundred acres?—Yes.

105. *Q.* He might change the field so long as he did not exceed the area?—Every village under command and which can be conveniently served by the canal should have one or two specified blocks to which irrigation should be confined; the people of the village must agree among themselves to practise irrigation in that block; people who have no land of their own may lease out plots from others, as is at present done, during the currency of the lease for water-supply. I should guarantee the water-supply for such blocks for six to seven years at a time.

106. *Q.* Don't you think six years too much?—No. We have sugarcane crop running six years without re-sowing. That is unusual of course; the usual custom is to have a *ratoon* crop for two or three years.

107. *Q.* (*Mr. Muir-Mackenzie.*)—Would you endeavour to make *phads*?—Yes; but people will do the distribution among themselves as they have done in Nasik and Khandesh; this point is explained in Mr. Beale's report.

108. *Q.* Within a certain area the cultivators would probably arrange their own rotation?—Yes. If we have a "fixed" area for which we guarantee water the people will lay out their money and manure their land; under the present system there is too much uncertainty.

109. *Q* (*The President.*)—Would you bind them to take water?—This is explained in paragraph 55, section 9 of my note (read out). The proposals I have made are, I think, under the present circumstances the best. If water were given to any and every part of a village, there would be serious loss. With the same quantity of water we shall probably be able to irrigate 50 per cent. more area in the block than if the irrigation were in scattered patches. I admit there will be some difficulty in giving opportunities to all cultivators to irrigate, but they can arrange among themselves and obtain plots either in exchange or by lease as at present. At present cultivators from parts of the district where there is no canal irrigation bring their capital and obtain lease of plots of land for sugarcane cultivation. The same might be done in connection with the blocks. Sanction to grant a block may be withheld until the villagers agree among themselves to give a share to a reasonable proportion of the cultivators in the village. This seems to be the best possible system under existing circumstances, but if a better system is suggested, we shall be glad to go into it and give it a trial.

The population of the Bombay Presidency according to the census of 1901 was 16 millions; the net cropped area is more than 19 million acres, giving a rate of more than 1 acre of cropped area per head of population. In all other provinces—*vide* Appendix I of my Memorandum—the rate per head is less than 1 acre. One reason why irrigation is not so extensively encouraged in this Presidency seems to be the large area cultivated compared with the population; if they get a good crop once in two or three years, they can afford to live on it.

Another point I wish to bring prominently to notice is the percentage of area of well irrigation on total cropped area; in Madras this percentage is 4·89, in Bombay it is 3·40, while the corresponding percentages for tank and canal irrigation are 19·50 and 0·70 for Madras and Bombay, respectively. I think these figures show that adequate provision is not made in Bombay, and that there is large scope for the extension of canal and tank irrigation in this part of the country.

I have said already that the proportion of cropped area to population is larger in the Bombay Presidency than elsewhere. Dry crop irrigation will not pay in Bombay; over 92 per cent. of the irrigation in Madras is under paddy or rice. If rice is excluded, other irrigation, including perennial, is small. Irrigation is mainly a question of rice cultivation in Madras. We have very little rice cultivation in the Deccan, because other food-grain crops like *juar* and *bajri* are grown on rainfall with less expenditure of labour and capital and less trouble than rice, which ordinarily requires irrigation in addition to rainfall.

110. *Q.* This country has suffered very much during the last few years from famine. Supposing you had reason to believe that in 10 years' time there would be another famine, what would you do for the Deccan before then?—Irrigation at the best will only be a partial remedy, but I should have works of several kinds—tanks fed by *ghât* rainfall. I should also try large canals constructed like the inundation canals elsewhere taken from rivers fed by *ghât* rainfall. These canals will have to be taken through rough country and will be expensive, but the expense must be faced. The water which is now running to the sea will be carried in these canals which in a year of drought will distribute moisture over the whole country; depressions along its course may be filled and tail tanks like those mentioned by Mr. Beale may be replenished; and subsoil water wherever such canals pass will be raised and well irrigation will be encouraged. The next class of works, though not the least important, are village tanks and weirs on small rivers; these may be largely extended. From this class of works Government should not expect a large revenue. If they did, there would be no progress, but the indirect results will more than repay

lakhs may be spent annually on irrigation works, 10 on large tanks and canals, and 2 on minor village tanks and river weirs. But the more money available the better.

111. *Q.* What works would you propose to spend it on?—It is important to have a proper hydrographic survey of the country first.

112. *Q.* That won't cost very much?—Only 1½ lakhs per annum for the next 8 to 10 years; there will then be some excellent schemes. Meantime we can carry out reasonably good schemes already projected.

113. *Q.* (*Mr. Muir-Mackenzie.*)—Why are you confident that the schemes will be excellent; you will remember that a large number of projects in connection with Lake Fife and the Maswad were prepared which it was thought would be excellent, but they were not so?—I would like a reference to paragraph 30 of my Memorandum, in which I have explained why the Deccan works were a failure. I have all along contended that if the works are managed on lines suited to local conditions, they will show better results than they do now. I have admitted, however, that Bombay works will never be as remunerative as works in Northern India. I don't ask that expenditure in this Presidency should be anything like what it is in other provinces, but there should be a reasonable allowance made to this Presidency also, which there is not at present.

114. *Q.* How are you sure that the mistakes made in the past won't occur again?—I think we are wiser now.

115. *Q.* (*Mr. Ibbetson.*)—Why do you think in ten years these schemes will repay Government when the present schemes don't?—They will pay indirectly and they will pay also a reasonable direct return if the present anomalies and difficulties are removed.

116. *Q.* Do you think the present schemes do pay Government?—The Mutha pays more than 3 per cent. and the Nira about 2 per cent. and on the two, if indirect results are taken into account, the return to Government, if I may risk an estimate, is probably more than 6 per cent.

117. *Q.* (*The President.*)—Do you put as your first condition certainty of supply?—That certainty is always possible in reservoirs fed by *ghât* rainfall.

118. *Q.* Having got your survey and knowing all about the country, where would you look for the first means of security; would you look to the storage of the *ghât* supply?—Yes, and then go to the plains.

119. *Q.* (*Mr. Higham.*)—With regard to the new storage works on the *ghâts*, I understand these are the only proposals made?—Yes, I have submitted rough schemes for four new tanks for this district.

120. *Q.* Are there any other possibilities of storage?—There must be several other sites. These are all that have been examined.

121. *Q.* Where?—In the northern parts of the Poona district. Also the existing works, the Nira and Mutha Canals, may be extended by increasing their storage by means of new tanks and by extending the canals and their distributaries.

122. *Q.* You can make more storage works than are shown here?—I think many more.

123. *Q.* Suppose you get a greater increase of storage tanks, could you use them?—We could if we work on the lines I have suggested now. We should extend the cultivation of crops which do not depend on rainfall.

124. *Q.* You would not extend your area of cultivation?—The total area may not increase; our cultivation in ordinary years should be intensive.

125. *Q.* I am speaking of this tract of the Poona district in which you have no irrigation; could you extend irrigation on that by finding more storage tanks in the *ghâts*?—I think so; no detailed surveys have been made; we have rough surveys made in some few instances showing that it is possible.

126. *Q.* Could you make a new branch to the Nira Canal and divert a portion of the supply to another part of the district, if you have a greater supply available at the head of the canal?—We can extend by taking a branch from the Nira Canal to Satara and Sholapur. Mr. Beale has an idea of having a branch canal.

127. *Q.* Provided you get water?—Yes; storage must be first provided. Before we think of extensions, we should increase storage for the Mutha Canal in this district. The present canal is 70 miles long and half of it is not working. There is ample scope for using all the water we can store up in the *ghâts*.

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128. *Q.* Could you command the north-eastern part of the district by the *ghât* tanks?—I believe so.

129. *Q.* What about the Bhima?—It is very low; it is very deep; but if we have a very high weir, it may be possible to take water for irrigation from it; whether such a scheme is financially possible depends upon the result of surveys.

130. *Q.* What about storage?—We should probably have to store water near the *ghâts* and take water a long way in the rivers and raise where required by means of pick-up weirs.

131. *Q.* Can't you store up on the *ghâts*?—We can, sir, but no regular surveys have been made.

132. *Q.* I suppose no proposals have been made because the river is much below the level of the country?—Yes, that is the general impression. But we may be able to find sites for reservoirs, though we shall have to go a long way to get command.

133. *Q.* Last year, 1900-01, you irrigated over 52,000 acres on the Nira Canal?—Yes; I can irrigate 100,000, if necessary. Area and the nature of crops irrigated should both be taken into consideration in estimating the results in any year.

134. *Q.* You irrigated 47,000 acres in 1897-98?—Yes.

135. *Q.* And 42,000 in 1896-97?—Yes.

136. *Q.* These were the largest areas?—Yes, in recent years.

137. *Q.* Were they all very dry years?—Yes, except 1897-98; when in order to replenish their stock of grain, the cultivators irrigated a very much larger area than usual; they did not wait for rain-water.

138. *Q.* What was your supply in 1897-98?—Our supply in the tanks was full.

139. *Q.* You had sufficient supply all through 1899?—No, in 1899 the Bhatghar Lake did not fill. We restricted our area and regulated our supply.

140. *Q.* This shows a much larger area because it includes a greater area of food crops and less of sugarcane?—Yes, the proportion of the sugarcane crop is only 10 per cent. on that canal.

141. *Q.* Of the normal area?—Yes, 10 per cent. of the normal area.

142. *Q.* How much this year?—We have got the same area, about 6,000 acres of perennial crops. I have not got the figures for the first official year here, as the Revenue Report is not out.

143. *Q.* You do not know what it was?—No, I have got figures for other years.

144. *Q.* You had a very small area in 1892-93?—Yes, the canal was young then, and not developed.

145. *Q.* In a wet year what is the effect on the area?—It will probably go down to 30,000 acres. If there is plenty of rain, water is taken only for perennial crops and a little perhaps for *juar*; some water is always taken for *rabi*.

146. *Q.* (*The President.*)—Is there any rice at all?—No; very little.

147. *Q.* Not worth mentioning?—No.

148. *Q.* (*Mr. Higham*)—Does sugarcane come under *kharif* or under *rabi*?—Under *kharif* (explains from the book).

149. *Q.* Take 1898-99; you had 34,000 acres; you say it was mostly perennial?—No, it was not mostly perennial.

150. *Q.* (*The President*)—You put it too strongly when you said that in a wet year there would be nothing but perennial crops?—I mean that in a wet year ¾ths of the revenue will be from perennial crops; that from the other crops would be very small, though their area may be comparatively large. But area alone is not a true index of the results. One acre of sugarcane is equivalent to 8 to 10 acres of dry crops.

151. *Q.* Under any circumstances would the area of perennial crops be more than 25 per cent.?—Never.

152. *Q.* (*Mr. Muir-Mackenzie.*)—By your system you can raise it to a third?—Yes, in the blocks only. Outside the blocks, the dry crop area will preponderate.

153. *Q.* How much of your area would be perennial under your system?—About 10 per cent.; perennial crops would get ⅓rd of the water-supply, but one acre of cane takes as much water as 15 acres of other crops, so the area would only be about ⅒th.

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154. *Q.* (*Mr. Higham.*)—You say—" we are not allowed to work on our own lines," who do you mean by " we "—the Local Government?—No, the Department.

155. *Q.* You are not allowed to work on your own system?—No, not in the manner we think best adapted to local circumstances.

156. *Q.* You attribute this to some orders of the Government of India?—Yes.

157. *Q.* What orders are they?—The Government of India have laid down a general policy for all the provinces.

158. *Q.* Where is that policy laid down? I do not see it here?—(Reads.) It is laid down here.

159. *Q.* You say this means that the canal is not to be worked for productive purposes?—That is what we generally understand.

160. *Q.* You say you are fettered by the Government of India. Where are the orders?—I do not say there is any specific order of the Government of India which applies to this Presidency alone, but the general impression of the Government of India is that where there is extensive irrigation that means protection. In our experience here protection does not mean production. Government have laid down general rules for all provinces, but they work badly here. We are guided by the rules and general policy of the Government of India.

161. *Q.* In this particular case the Government of India merely remark that in a season of drought there has been a decrease of area. It is usual to expect an increase of area in a dry year. It seems a harmless remark on which to base such an assertion?—But increase of area means, in a large number of cases, decrease in revenue in the special circumstances of this Presidency.

162. *Q.* That remark may be made in regard to any canal in a season of drought. I do not see how you can construe it in the way you do?—For this reason; our water-supply in a year of drought is limited and we have to help the perennial crops of the previous year and provide water for a reasonable area of new sowings of the same class of crops. If water is diverted from these to increase the area of dry crops, irrigation of perennial crops would be disorganised. In this Presidency we ought to look to valuable crops rather than to extension of area.

163. *Q.* You have no other order to restrict your supply to protection of dry crops?—No direct orders. I think it is the impression of the Government of India that wherever there is extension of area under irrigation there is protection. Protection means production elsewhere, but not here.

164. *Q.* Has your Public Works Department ever made any representation to Government on the matter?—I think so. I cannot say definitely what they have done, but they must have represented the difficulties several times.

165. *Q.* To explain your plan a little more fully why do you restrict the area to ⅓rd of the available water-supply?—Because we can guarantee water-supply to that extent only in a year of drought.

166. *Q.* Why don't you propose to restrict to 13,000 acres?—Because you object to our working the canal on productive lines in ordinary years and protective in famine years. Possibly I may not be very clear; it is not ⅓rd of the area; it is ⅓rd of the water-supply.

167. *Q.* One-third of the water-supply?—Yes; I would set that apart for perennial crops every year; that would give fixity to irrigation.

168. *Q.* You guarantee ⅓rd of the water-supply to perennial crops?—Yes, to the blocks in which I propose to carry on " fixed " irrigation.

169. *Q.* They can use the water for what they like?—No; I would have about one-third of the area only under sugarcane; some such condition would have to be put in.

170. *Q.* You would not interfere in any way with the village?—Not so long as they manage properly. If they wasted water or quarrelled among themselves, we may interfere and regulate.

171. *Q.* Will they not look upon it as a permanent assessment?—We don't want permanent assessment; we only want fixity for six or seven years. I should accept joint applications from each village for six years.

172. *Q.* What would you charge for ⅓rd water-supply?—About Rs. 12 to Rs. 15 per acre.

173. *Q.* If you guarantee ⅓rd of the supply, how can you charge upon acreage?—The area which ⅓rd of the supply annually available can irrigate will be estimated. This area will be distributed among the villages. There will be a fixed rate per acre on this area. The only condition imposed will be that the area under sugarcane should not be more than ⅓rd of the total area of the block.

174. *Q.* You will estimate what the area would be?—Yes, approximately. It is much easier to estimate for a block than for a field.

175. *Q.* Will you measure the area every year?—No; once measured, the " fixed " area is known.

176. *Q.* You say—" I give you for six years ⅓rd supply and we estimate that you should irrigate so many acres?"—But ⅓rd of the supply has nothing to do with the individual villages. The entire area of the blocks of all the villages will require ⅓rd of the supply.

177. *Q.* Suppose the supply is short?—We guarantee only ⅓rd of the minimum available supply. Our *ghât* fed tanks always fill, even in a year of severe drought.

178. *Q.* (*The President.*)—For statistical purposes you would measure up the area?—Blocks are fixed for six years and the area is known. No measurement is necessary every year.

179. *Q.* Suppose a man has got one or two fields outside the area and puts in sugarcane?—We would not give him water except on the permissible system.

180. *Q.* (*Mr. Muir-Mackenzie.*)—Do you take it for granted that they would take water?—They are willing to take it on these lines on the Nira Canal; people have already sent in applications. I believe the Local Government is favourably disposed to give the scheme a trial if it is shown to be practicable.

181. *Q.* (*Mr. Higham.*)—You think you will irrigate a larger area of perennial crops if you guarantee them ⅓rd of the supply than they have irrigated in the past?—Yes, we have now 5,000 acres of sugarcane on the Nira that brings about a lakh of revenue; we should have 7,000 under my scheme.

182. *Q.* Why?—Because during years of good rainfall we can give water for perennial crops which in bad years will be protected by wells.

183. *Q.* What would prevent them from putting down sugarcane now under the present system?—They are not sure of the water-supply; if rain fails, we restrict the supply.

184. *Q.* The cultivation of perennial crops on the Mutha Canal is now more or less a gamble?—I think so, as regards ⅓rd or ¼th of the area.

185. *Q.* Is the supply to perennial crops uncertain on the Nira Canal?—Yes, it depends on the locality. In the upper reaches the crops are practically safe. In the middle of the canal the supply is uncertain.

186. *Q.* Taking an average?—About ¼th is uncertain.

187. *Q.* (*Mr. Ibbetson.*)—There would be less gambling under your new system?—Yes.

188. *Q.* And then in addition to that you would have also the 'perennial' area on which there would be a certain amount of chance?—Yes, that is a great point.

189. *Q.* (*Mr. Higham.*)—What do the people do in the year of famine; do they reduce the area of cane of their own accord and increase the area of food crops?—We reduce the area of sugarcane for them; the whole thing is done by us. My experience in this district is that the demand for sugarcane in a bad year is as great as in ordinary years.

190. *Q.* I think the Bombay Government have several times explained the reduction in the area under sugarcane as due to famine and plague?—It was due to the low rate of raw sugar in 1897 and 1898; these abnormal causes operated also. But since 1899, in which year I took charge of these canals, the demand for water for sugarcane has been as keen as for dry crops.

191. *Q.* Ordinarily considered, people would cultivate as much cane as they possibly can even in a famine?—Yes; that is the tendency.

192. *Q.* I suppose in a famine year an acre of cane is quite as good as an acre of fodder crops?—A great deal better; it will employ more men and for 12 months instead of 4.

193. *Q.* An acre of sugarcane requires more water than an acre of dry crops?—Yes; about 8 to 10 times more. The gross produce per acre of sugarcane is valued at about Rs. 600 and fodder crops fetch about Rs. 80 in a famine year and Rs. 30 in ordinary years.

194. *Q.* (*The President.*)—How many cubic feet do you require for an acre of sugarcane?—About 3 or 4 lakhs

of cubic feet. The yield of cane is worth about 7½ times that from *rabi* crops.

195. *Q.* It will pay you better to use your water upon dry crops than it will upon sugarcane crop if sugarcane takes 10 times the amount of water and only yields 7½ times the produce?—But the demand for sugarcane is constant; not so for the dry crops. Besides, the dry crops require water either in the monsoon or in the *rabi* season when the water is not so valuable.

196. *Q.* Could you irrigate seven times as great an area of dry crops as you could of cane if you stop sugarcane altogether?—Ten times more of *rabi*; for every acre of cane we can irrigate 10 or 12 acres of dry crops.

197. *Q.* Would water be taken?—Only in years of drought, not always. For perennial crops the demand is constant.

198. *Q.* (*Mr. Muir-Mackenzie.*)—Do you think that the rates now charged on the Nira Canal are unnecessarily low? Do you think that people can pay a higher rate?—I think the rates are very good now, but they are capable of increase in three or four years' time.

199. *Q.* Why must we wait?—On account of famine.

200. *Q.* People on the canal are rich and prices of crops have risen?—Yes.

201. *Q.* Why do you say we ought not to increase them; I ask you generally whether the rates charged are, in your opinion, excessive or too low?—For ordinary, dry, and monsoon crops the rates are fair; for cane the rate is low.

202. *Q.* How long ago were these rates discussed?—On the Nira Canal very recently; on account of famine they have not enhanced the rates.

203. *Q.* (*Mr. Higham.*)—Could you give me details of your expenditure on Revenue establishment—the establishment that you have to maintain on the Nira Canal?—Yes. (Refers to statement I-C.)

204. *Q.* What is your charge on establishment?—About 20 per cent. of the gross revenue.

205. *Q.* What do you allow for collection?—Five per cent. on total receipts.

206. *Q.* Who does that go to?—The Civil Department.

207. *Q.* Twenty-five per cent. is taken for the maintenance of local establishment?—Yes.

208. *Q.* Do you know how they exactly divide the establishment between the works and revenue?—We have got a certain amount of expenditure on works and repairs; on that they charge 25 per cent. The whole of the balance goes against the Revenue establishment.

209. *Q.* You recommend as one means of protecting the provinces from famine that the Government of India should allow you to spend about 10 lakhs a year on new works?—Yes.

210. *Q.* Is that 10 lakhs for the whole province or for the Poona district?—For the Presidency proper, excluding Sind.

211. *Q.* I think the cost of irrigation works on an average is about Rs. 200 per acre?—Yes, according to the present system of accounts.

212. *Q.* Ten lakhs a year would ultimately go to increase the area by 5,000 acres per annum?—Yes.

213. *Q* At the end of 20 years you would be prepared to meet famine with 100,000 acres?—Yes, it looks small, but it would mean double the present area.

214. *Q.* What percentage would that be of the area under cultivation?—Something very small; I do not expect any great results from irrigation alone; have said so in my Memorandum.

215. *Q.* You say double the present area?—It is not enough; if you give 20 lakhs it would be a very good thing.—I only mentioned what we were likely to get; not what I thought was necessary. Before the famine we were getting 1 or 2 lakhs a year. So 10 lakhs are a large amount comparatively. I would welcome 20 to 30 lakhs.

216. *Q.* (*Mr. Ibbetson.*)—The cane is a very valuable crop; you cannot afford to risk it; it takes a large quantity of water; you must know how much you have to provide for. In your note you say the cultivator grows fodder crops in the hope of being able to do it without your water; he goes on waiting from day to day hoping for rain and when he does want your water he wants it in a hurry and must get it at once; any delay on account of his having to submit an application would be very injurious; would it do to have applications for cane only, to give the cane area preference but allow people to use the balance of the water as they liked?—In the monsoon there is no difficulty; on many canals there is some water to spare and this they can use. There is a Government order permitting us to give water for dry crops without waiting for application.

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217. *Q.* Have you never in your time imposed double rates on men for taking water without application?—Not on dry crops, except when all the water was required for crops for which water applications had been accepted.

218. *Q.* Why not extend the same principle, to those who take water for fodder crop, wheat, gram and *juar* when they choose at the end of monsoon as long as you get your sugarcane watered?—Our water-supply becomes very valuable after the monsoon. Our stock is limited and we have to use it in as profitable a manner as possible. We have to regulate between sugarcane and other crops.

219. *Q.* Suppose you give sugarcane the preference, then would you give water for other crops without application?—Only where we have an ultimated supply. The supply is so uncertain; we have to look ahead and provide for sugarcane sowings in March or April.

220. *Q.* Before 1896, I understand that a great deal of your water was unused on these canals?—To a great extent; it was in 1898 also; but we never have any water unused in these days, not during these last three years.

221. *Q.* Before that?—The people would not take it.

222. *Q.* Would they not have used your water if you had allowed them to take it without making an application?—It might have had some slight effect; perhaps about 5 per cent., but we did not want to let the area to go out of our hands.

223. *Q.* In a good year you abolish application?—No, we relax stringency, in accordance with the orders of Government.

224. *Q.* The application system would only be worked strictly in a bad year?—Yes, but sometimes we have to place restriction year after year, except in the monsoon, if there is a considerable extension of perennial crops under the canal. This remark applies to the Mutha Canal only, which is a productive work.

225. *Q.* In your scheme of irrigation you guarantee ⅓rd of the water-supply, presumably for cane irrigation, and give ⅓rd on your 'permissible' system; if people are willing to give ⅓rd on your 'permissible' system why not get the first ⅓rd taken on the same terms, that is, have ⅔rds 'permissible' and no 'fixed' area?—Because in the permissible area then there would be uncertainty of cultivation; water would not be available in a year of drought.

226. *Q.* Do you think they will always prepare their land for ⅓rd if it is fixed?—Yes.

227. *Q.* They won't prepare for ⅔rds?—They will sow every year; my object in having ⅓rd permissible is to have ⅓rd of the water-supply in a famine year for dry crops. They prefer to have an assured supply which would only be available for the "fixed" area.

228. *Q.* (*Mr. Muir-Mackenzie.*)—If you don't have a fixed area you don't get extension?—No.

229. *Q.* (*Mr. Ibbetson.*)—You say this permissible water would be very largely used by people with wells?—Yes.

230. *Q.* Is it not waste to give canal water to people who have got wells?—It pays them to use canal water. If they are left to wells alone, unaided by canal water in good years, they will abandon irrigation.

231. *Q.* Speaking of tanks, you say "smaller tanks perform a useful office in Madras, namely, to protect the rice crop during a break in the weather." Why should not they do the same in the Deccan?—Because they have rice in Madras; we have no rice here.

232. *Q.* Is there no rice in the Deccan?—Very little; there is rice on the hills, of an inferior kind; it does not pay the cultivators to go to the expense of rice cultivation there.

233. *Q.* Would small tanks be of use generally in the Deccan?—Yes, small tanks will do good in many ways.

234. *Q.* How?—There will be moisture and the water-level in wells will be high in the neighbourhood.

235. *Q.* Would there be any irrigation?—A little perhaps; indirect irrigation from wells there will be.

236. *Q.* Directly they won't pay?—No; small tanks will not pay in the Deccan.

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237. *Q.* Do you think people would be ready to contribute for their construction?—I think they may be asked. The experiment is worth a trial.

238. *Q.* You say—"one reason why well irrigation is not largely practised is that the subsoil over wide areas is rocky which makes well excavation a matter of great expense." Do you think people would use wells largely if they had them; would it be profitable to work them irrespective of the cost of making them?—In a famine year they would pay.

239. *Q.* That would be one year in ten?—Yes.

240. *Q.* Would it pay a man to use a well if it were made for him?—It would depend on the enterprise of the man; if capital and manure were forthcoming, it would pay.

241. *Q.* You say that it is by artificial debits that working expenses are enhanced?—Not as regards the working expenses; the charges are fair on the Nira and Mutha Canals; but in regard to capital expenditure there are artificial debits.

242. *Q.* Is the capital expenditure enhanced?—Yes; to some extent by artificial debits.

243. *Q.* On the Mutha and Nira Canals you have separate establishments for supervision of irrigation?—Yes.

244. *Q.* Your working charges are actually what it costs?—Yes.

245. *Q.* There is no artificial debit?—I am not prepared to go so far as that.

246. *Q.* Is there a large artificial debit?—No.

247. *Q.* They are mainly actual?—Yes.

248. *Q.* You say that the actual average working expenses would be about Rs. 3 per acre?—Yes, they vary; Rs. 3 are for the whole area in the Presidency. On the Mutha Canal the working expenses amount to Rs. 7, because the principal crop is sugarcane.

249. *Q.* You say that an acre of cane costs much more for maintenance than an acre of *juari*?—Yes.

250. *Q.* What makes up Rs. 7?—Maintenance, repairs, and establishment.

251. *Q.* You say the average is Rs. 3, and cane, which forms a substantial portion of your crops, costs Rs. 7. What does *juari* and wheat cost?—A good deal less.

252. *Q.* Could you give me an idea?—Say Rs. 1-8.

253. *Q.* Suppose you double the area of wheat and *juari* you would not double your expenses?—No, we would reduce them, that is, judged by the rate per acre.

254. *Q.* Your Rs. 3 includes all crops?—Yes.

255. *Q.* What is Rs. 1-8?—For wheat and *rabi* crops only; the average is Rs. 3.

256. *Q.* As *rabi* only pays Rs. 2 and working expenses are Rs. 3, therefore you say it would not pay you to increase your area under wheat?—I am referring to the results in the whole Presidency. We have got about 100,000 acres under irrigation. I have said the total area considered irrigable is 300,000; supposing we had all these 300,000 under *rabi* area, our total revenue would be less than what it is now.

257. *Q.* On page 13 you say—"the Executive Engineer is required to keep his tanks and canals up to a certain standard of efficiency and when he has done this the water may run to waste or remain locked up in the tanks for all he cares." Is this an exaggeration?—I say so to make the position clear. We have not worked that way in this district.

258. *Q.* What I want to know is this. Is there anything in the present system which could show to the Executive Engineer how the canal pays?—The Revenue Report shows that.

259. *Q.* Not until the Revenue Report comes?—No; the final figures are sent to the press by the Examiner, Public Works Accounts.

260. *Q.* Could he not get an idea?—Yes, a rough idea from areas and expenditure in his own accounts.

261. *Q.* Is there anything which you would suggest to enable the Executive Engineer to have a keener insight into the use of water?—I think the Executive Engineer must study carefully the irrigating capacity of the work, and watch the operations from week to week; otherwise if there is a deficiency of water the crops will suffer or water may be locked up and remains unused.

262. *Q.* All these things depend on the man who has charge?—Yes; I have got charge of the Mutha Canal, and if I do not clear the silt, I may show a saving of, say, Rs. 10,000, and get credit, the resulting evil effects will not be felt in my time, but in my successors.

263. *Q.* Is there then anything you could suggest that would give the Executive Engineer a keener insight?—If a programme is drawn up to see month by month what water there is and what area under irrigation, the Executive Engineer will be able to take steps to stop extension of irrigation if the water-supply is scanty, or to extend the same if the supply be abundant. If they know that we are able to give water liberally, probably people at the tail of the canal will take it. There has always been less water than there was demand for in my time.

264. *Q.* You never had surplus water?—We never had more water than we could use during the last three years. In good years they do not want it for ordinary dry crops, and then there is a surplus.

265. *Q.* Do you know the reason of the difference between Imperial and Provincial districts?—There are several classes of works in progress in a district. Irrigation Work (Imperial), Military Works (Imperial), Roads and Buildings (Provincial). The district is classed as Imperial if works of that class preponderate, or Provincial, if the major portion of the expenditure in the district is from Provincial funds. Certain fixed percentages are charged for establishment on all miscellaneous works and the balance of expenditure debited *en bloc* to the class of works which decides the classification of the district. In the Sholapur district only fixed percentages are charged on irrigation works (refers to para. 36 and reads from appendix, page 23), and the result is the establishment charges are very low in that district.

266. *Q.* At page 10, paragraph 36 of your note, you say —"Total cost of maintenance, including share of revenue management." What is the share?—They charge 25 per cent. on actual works expenditure.

267. *Q.* Of the two canals, which do you say is protective?—The Nira.

268. *Q.* I understand that you actually held up water in reserve in order to provide against a year of drought?—Yes.

269. *Q* Are there any orders to that effect?—It is regulated by practice and by the general impression that the Government of India want a large area of food and fodder crops to be irrigated, especially during years of scarcity.

270. *Q.* The general impression is that the Government of India wish that food and fodder crops should be protected?—Yes.

271. *Q.* There are no specific orders?—I have already quoted some orders which can be read that way. I have also explained why the Government of India associate increased area with improved results.

272. *Q.* You say you cannot give sufficient water for high class crops?—Yes, now-a-days, to the extent there is demand for it.

273. *Q.* Practically there is no demand for water, except for these high class crops, in a year of fair rainfall?—No large demand.

274. *Q.* We were told yesterday that certain people would take any amount of water for dry crops if you give it every year?—There is no demand for dry crops; they won't take the water; they will wait till the last moment for rain, and if rain fails, then they rush for canal water.

275. *Q.* They won't begin to irrigate before they know that the rain will not come?—Yes, they won't insure their crops beforehand.

276. *Q.* You say—"fear of enhancement of revenue exists in the case of well irrigation;" do you say that from your own knowledge?—The statement may not be correct; I have heard reports, but have no personal knowledge.

277. *Q.* (*Mr. Muir-Mackenzie.*)—Have you ever heard people say so?—Yes; I think it is not a fact.

278. *Q.* (*Mr. Ibbetson.*)—There is no enhancement, but they are afraid?—Yes, there is no doubt about that. It would be a good thing if Government published their intention broadcast; then there will be no fear.

279. *Q.* Do you suppose that in this district there is one year of famine in ten?—I could not say. There have been four bad years within the past six years.

280. *Q.* How many scanty rainfalls are there in ten years?—In the eastern part of the district it would be quite five.

281. *Q.* In the western parts?—Nine years out of ten are fairly good.

282. *Q.* How many years in the eastern part?—Four good years, five bad years, and one a famine or very bad year.

283. *Q.* Do you know why Government has prohibited the irrigation of sugarcane in the neighbourhood of towns and villages?—For sanitary reasons.

284. *Q.* Are you forbidden to give water to sugarcane within a quarter of a mile from the villages?—Yes; if there is a nullah between, water is allowed; otherwise irrigation of perennial crops is generally forbidden, within ¼ mile of villages.

285. *Q.* (*Mr. Muir-Mackenzie.*)—Is there an order to that effect?—Yes.

286. *Q.* Can you produce it?—Yes, I can. There are strong objections to a heavily manured crop in the vicinity of a village.

287. *Q.* (*Mr. Ibbetson.*)—What kinds of crop are heavily manured?—Sugarcane especially. Whenever there was irrigation formerly it is not prevented; but only extension of irrigation to new lands within ¼ mile is.

288. *Q.* Is compensation given to water-logged lands?—I have never received an application; I should think Government would be very favourably disposed to consider applications in cases where any real damage is caused by water-logging.

289. *Q.* (*Mr. Rajaratna Mdlr.*)—I find that the capital outlay on irrigation works in the Bombay Presidency, direct and indirect, was 486 lakhs, of which you have only cleared off 5 lakhs to the end of the year, thus leaving a large amount on the wrong side of the account. No wonder the Government of India objects to further grants; can you tell me how this is?—It is due chiefly to accumulation of interest charges. I have already said that our works do not pay. The yearly net revenue falls short of the interest charges on the capital laid out.

290. *Q.* Now turn to the Mutha Canal, do you know that the capital outlay was 62 lakhs and the interest 62 lakhs. Why is the interest so high?—The work was spread over a number of years, and though practically completed in about 1875, there are works still going on which are charged to capital. Besides, the yearly net revenue does not yet cover the interest charges on the capital.

291. *Q.* (*The President.*)—I suppose the dam was very costly and the cost high in proportion to the size of the canal?—Yes, also it took many years to complete the work.

292. *Q.* (*Mr. Rajaratna Mdlr.*)—Do you think it possible that by building storage works you could make the canals pay a larger return?—Yes. At the present moment there are two schemes for increasing the storage of the Mutha Canal under consideration. The proposed storage reservoirs will probably cost from 15 to 18 lakhs of rupees. They are mentioned in Mr. Beale's report.

293. *Q.* They have not been forwarded to the Government of India?—No. They are only rough estimates based on preliminary surveys.

294. *Q.* On the first page of your answers you give the cultivable area as 289,981; what does that represent?—The total cultivable area commanded by the new irrigation works in the Poona district.

295. *Q.* Will the existing works irrigate that large area?—That is only the area commanded.

296. *Q.* The actual area irrigated is not given; can you tell what the area irrigated will be when all the works are completed?—I cannot give it for the whole Presidency; in the Poona district about 65,000 to 100,000 acres can be irrigated annually.

297. *Q.* Could you irrigate a larger area if you extended the area of dry crops?—Yes, we could make the Nira Canal works irrigate a larger area if we gave a larger amount of water to dry crops than we at present do, but more area means inferior crops.

298. *Q.* Against the Mutha Canal large revenues are shown under miscellaneous, indirect and direct. Can you explain it?—They include receipts from the water-supply to the Poona Cantonment, which amount to about Rs. 1,25,000.

299. *Q.* On the Nira and Mutha Canals how much sugarcane or perennial crops is under irrigation?—Under the Mutha about 4,500 acres and on the Nira about 5,600 acres.

300 *Q* Can these areas be increased?—Yes, if we reduce the other class of irrigation. On the Mutha we have reached the limit, but on the Nira we could decrease the area of *rabi* crops and increase that under perennial.

301. *Q.* I notice that the *rabi* crop except in years of drought is 14 or 15 thousand?—That is during years of very seasonable rainfall; ordinarily the area is about 25 thousand acres.

302. *Q.* On page 4 of your note you say that irrigation works get no credit for increase in land revenue. Do you get no credit?—We get practically none. They get 90 per cent. in Sind. We do not increase the land revenue here on account of the canals. Perhaps you refer to 2nd class irrigation works such as *bandharas* on which a consolidated rate is fixed. On these we get about 65 per cent. of the consolidated rate credited to the works. Under first class works no portion of the land revenue is credited to the works.

303. *Q.* If you add the water-rate to the land assessment, what proportion is the water-rate?—The Nira Canal is what is called a Capital Account work and land-rate and water-rate have no connection with one another. In the case of 2nd class works, the figures are given in the Irrigation Revenue Report for the Bombay Presidency.

304. *Q.* When waste lands are brought under cultivation for the first time, do you not take credit for land assessment in addition to the water-rate?—No, I am not aware of any such credit.

305. *Q.* You say you would have a fixed area for which you would allow irrigation under your "block" system; will not this benefit only a favoured few?—The blocks, it is true, will be on land owned by a few people, but all the villagers who require to participate may obtain share of the area by exchange or lease for the period the water-supply is guaranteed to the block. The water-supply to a block will be granted only after the villagers have come to a satisfactory agreement among themselves in this respect.

306. *Q.* You fix the block in the holdings of two or three rayats; would it not be possible to fix a share in each rayat's holding?—If we give a water-supply to any field wherever situated, the waste of water would be very serious. The water which would be saved under the block system would probably suffice for one-third to one-half more area. There is now a lot of waste from field to field on the distributaries.

307. *Q.* Is your plan workable in practice?—Yes, I think so.

308. *Q.* But only a certain number of rayats will benefit by it?—We propose blocks of 50 acres or more, and we propose that all the villagers should share in the benefits of the fixed area.

309. *Q.* I think there is a serious objection to fix the block at 50 acres. Why not apportion it according to the holdings?—Yes, you may do that.

310 *Q.* According to your plan the poorer men will be excluded?—We can easily frame rules to bring in all who want a share. Before sanctioning a block, the cultivators should be asked to come to an understanding among themselves in this respect. Obtaining land by lease for sugarcane cultivation is a common practice in this district.

311. *Q.* On page 8 of your note you say that on the Nira Canal the rate paid is 15 to 20 rupees for sugarcane; is that the maximum; don't you charge 40 to 50 rupees sometimes?—The rate given is the average rate for sugarcane.

312. *Q.* In regard to clause 3 of the same paragraph on page 8 is the rate charged on the whole area or only the irrigated area?—On the whole area, whether irrigated or not.

313. *Q.* In regard to paragraph 22 on page 9, have there been no cases of private canals?—Not that I am aware of.

314. *Q.* Do you permit the construction of canals if the people consent to pay enhanced water-rates?—If they build them at their own cost, we may remit the water-rate for, say, ten years.

315. *Q.* Is there scope for private canals in the Poona district?—Yes, if liberal concessions are given, but Government should be prepared to lose money. Either Government should construct the canals themselves or forego irrigation rates for a long time. The people want a quick return.

316. *Q.* If we gave remission for five or ten years, would that induce the people? Would capitalists take the matter up?—Yes, but there is the question of ownership of land.

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317. *Q.* But supposing Government assisted them in acquiring lands?—Then I think extension on minor streams would be possible to a very limited extent.

318. *Q.* Now in regard to the system of applications from rayats, you know what area is irrigated; could you not dispense with the applications, subject to the condition that if a man wishes to change his four-month crop into perennial he must apply?—There are three or four classes of crops and I do not think it would be possible.

319. *Q.* For each village the area is known. You make your approximate estimate and tell the rayat that he is at liberty to take water until he changes his crop. Would that not work?—The cultivators change their crops so often that there would be trouble in regard to the sufficiency of the water-supply. I am sure it is not possible on these canals. If we bound ourselves to give water, the agriculturists might sow perennial or *rabi* or any other class of crops. This varies according to the nature of the crops, and if a large proportion is perennial or rich crops which require water, say, in the hot weather, the water-supply may fail. For regulation of water-supply, both area and class of crops irrigated should be known.

320. *Q.* But if they change the crops, they must tell you?—I don't think they will take water on those terms as they constantly change. The notices would give quite as much trouble as the applications.

321. *Q.* But the notices would be fewer than the applications?—Yes, but it is most necessary that we should know, especially in seasons of drought, what crops we are to have.

322. *Q.* You can measure them up?—There would be practical working difficulties. We might do it over a restricted area, but not over the whole district. We want to know early what water is required, as we may have to restrict the new sowing of sugarcane or perennial crops.

323. *Q.* I don't see what the difficulties are?—There would be serious difficulties. Your proposals would do for small tanks, but not for such large works as we have in thi district. We must know within 100 to 150 acres what crops we have to give water to. The crops sown in a good year may extend to a year of drought and fail for want of a sufficient water-supply.

324. *Q.* (*Mr. Muir-Mackenzie.*)—I notice that in Mr. Beale's report the working expenses of the Nira Canal are only 1·75 in ordinary years and Re. 1 in a maximum year. I do not understand the Rs. 3 per acre that you mention in your note. Do you mean both the Nira and Mutha, or the Nira alone?—About Rs. 3 is the average rate of working expenses for the whole Presidency. It includes artificial debits. *Vide* page 29 of the Irrigation Revenue Report for 1899-1900.

325. *Q.* What about the Mutha?—The average does not hold good for the Mutha Canal, as the crops grown under it are chiefly sugarcane or other perennial crops, and the rate of working expenses for such crops is very high.

326. *Q.* On the Pravara river and the Lakh Canals the average in ordinary years is Rs. 18?—That is an artificial rate, not the actual.

327. *Q.* Also on the Kadwa?—Yes. The high charges in both Nasik and Ahmadnagar districts are due to their artificial classification as "Imperial" districts, as explained on page 10 of my Memorandum.

328. *Q.* On a work like the Maladevi, which will irrigate 30,000 acres in ordinary times and 60,000 at other times, the conditions are not dissimilar to those of the Nira. Will the irrigation charges be higher than those of the Nira?—No. Mr. Beale had calculated the charges on the maximum area, whereas it should be calculated on the average, which will be a much smaller area. If the work is in an Irrigation Division, we might expect a little over Re. 1, though Mr. Beale estimates Rs. 3.

329. *Q.* I gather that there is no doubt that in years of ordinary rainfall you have a considerable amount of water to spare in the Nira?—We have had no such experience since the drought overtook us, but previous to that there used to be a surplus.

330. *Q.* In a year of good rainfall, might not you dispense with the applications, other than for cane, after the monsoon has declared itself?—Yes, but in that case we would have to enlarge our distributaries, as the crops sown might otherwise come to harm. In the monsoon there would be no great difficulty. We do allow the cultivators to take water in the monsoon before sanctioning the applications.

331. *Q.* After the monsoon?—After the monsoon we work the rules very strictly, as we have to be very careful. Otherwise the water-supply may fail and the crops may be ruined.

332. *Q.* You generally know about September whether you will have a good rainfall. Well, if you were assured of that, could you not dispense with the applications?—We have on the Nira about 100 miles of canal and the discharge in the hot weather is often not more than 100 cubic feet per second, and if we dispense with applications the cultivators would probably use the whole supply up early in the season. We might dispense with applications in regard to the upper 30 miles of the canal, but even in that reach the area under irrigation should be determined by measurement for regulation of the water-supply.

333. *Q.* But if you are sure there would be water?—We have distributaries of limited discharging capacity. They would have to be enlarged so as to be able to carry the maximum supply that might be required.

334. *Q.* In order to get rid of those applications you might increase your outlets?—Yes, we might do that.

335. *Q.* Have you any hope that if you dispense with the applications the people would irrigate more?—They won't irrigate much more than they do now; I think there might be an increase of 5 or 10 per cent. If you remove all restrictions, there would be an increase, but there is the question of practicability. We might try it over restricted areas if a trial is necessary.

336. *Q.* I understand that the prohibition to the cultivation of perennial crops near towns and villages is restricted to future extensions only?—Yes. That is so.

337. *Q.* Do you use *poudrette* on the Nira Canal?—Yes, the people are now collecting night-soil in the villages.

338. *Q.* And fish manure?—Yes, they are using fish manure also.

339. *Q.* But they do use night-soil in the Nira Canal villages?—Yes, they do use it to some extent; they get it from the rubbish heaps. They don't collect it systematically except in Baramati.

340. *Q.* Mr. Mollison informs us that in Khed they are taking great pains to collect it?—I don't know about Khed, I know they use *poudrette*, fish and oil-cake largely on the Nira and Mutha Canals. They get the cake from Gujerat and the Sabarmati.

341. *Q.* Is safflower cake not used?--I cannot say.

342. *Q.* Is it your experience that the people fear enhancement of revenue if they sink wells?—Though I cannot give any definite instances, that is the general opinion.

343. *Q.* Have you noticed that it has any effect in deterring the people from applying for *takavi*?—I should not like to say; I have no personal experience one way or the other.

344. *Q.* You say that if Government construct wells in private holdings the wells will be more expensive by reason of the cultivators' labour not being utilized?—The work will be more substantial and last longer but will cost more.

345. *Q.* If the cultivator can make it for Rs. 500, how much will Government spend?—There will be a want of personal interest in Government servants, and I think the expenses will be about 50 per cent. more.

346. *Q.* To come to this "fixed" area of yours, I understand that it is fixed not only in the matter of extent, but also in the matter of locality. You are particularly anxious that certain plots should be fixed?—Yes, my object is to save loss of water. Under old works, you notice, the *thals* or irrigable areas are fixed in this way.

347. *Q.* You would like to see large storage tanks in the *ghâts*; do you mean that they must be located in the *ghâts*?—Not necessarily; suitable sites on the rivers would do well enough. But the further away you make them from the *ghâts*; the higher would the dams have to be and masonry dams are expensive. Very high earth dams are a source of danger in the monsoons.

348. *Q.* Would the *ghât* tanks lend themselves to famine labour?—Not often, but people could be employed on the canals.

349. *Q.* Would you kindly tell me whether you think that the crops in the famine year on the Nira Canal were equal to or superior to the crops grown in other parts in a year of good rainfall?—Yes, the yield was equal to that of a year of good rainfall; it was more valuable and fetched higher prices.

350. *Q.* You would never get a 16-anna crop from the land?—We would often get a 12 to 15-anna crop, but never less than 8 annas.

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351. *Q.* Would you like to see the whole area given up to perennial crops in ordinary years?—No, I would not like the whole area given up to perennial crops. I would like the dry crop to go on by rotation to a certain extent, as they keep the distributaries in order to render the watering of large areas easy in times of famine at short notice It is not difficult to restrict the perennial areas in famine years.

352. *Q.* Supposing the restrictions were removed, would it be possible to supply water for the dry crops in famine years?—Yes, but there would be great difficulty after the beginning of the *rabi* season. We might have a large area to water and an insufficient water-supply.

353. *Q.* If you managed the works on productive principles, would it be difficult to make them protective in a year of famine?—Yes, if managed solely on productive principles in ordinary years.

354. *Q.* If you work on productive principles, there is great danger of the works losing their protective characteristic in a year of famine?—That is so if by protection is meant the saving of dry crops.

355. *Q.* If a crop is grown in black cotton soil this year, it must be manured to give a good crop the following year; unless manured an inferior crop will result. That is an established fact; is not that so?—Yes.

356. *Q.* Do you believe that irrigation is of value in deep black cotton soil without a *muram* sub-soil?—With light waterings and sufficient manure, deep black cotton soil may be utilized for irrigation to some extent, chiefly for the richer classes of crops.

357. *Q.* It is a soil not requiring a great deal of water?—Yes. They raise garden crops on such soil from wells.

358. *Q.* On deep black cotton soils?—Yes, they are irrigated by wells to a certain extent in this and other Deccan districts. They are not good for growing, by irrigation, crops usually grown on rainfall.

The Reverend Mr. H. GATES, Sholapur.

(*Sholapur, 4th January 1902*).

Revd. Mr. H. Gates.

1. *Q.* (*The President.*)—Have you been long resident at Sholapur?—About 25 years.

2. *Q.* You know the district well and have seen it through its times of famine and prosperity. You are resident in Sholapur itself?—Yes.

3. *Q.* After the experience of these last sad years, what do you consider would be the best and most reasonable measure for Government to take, in order to make the physical and moral distress less on the recurrence of a famine?—I have thought of this question considerably and of ways of getting water; there seem to me to be only two ways of getting it: first, by raising it from the ground; and, secondly, by taking surface water. I think that an improvement is possible in both these ways. I am not confident that much can be done in the way of artesian wells; the strata of rocks are too level for success; there must be a variation in the under-lying impervious strata; there are some variations in places where water can be more easily obtained than in others, and I think it would be well to find out where these places are so as to help the people to get water. I have not had much experience in well boring, although an experiment was tried in Sholapur, but it seems to me that if well boring machinery were introduced by Government, trial borings might be made in certain places, so that the people could find out where they would be likely to find water; if, for instance, such machinery were put in the hands of the Collector, it could be sent to different sections of the Collectorate and trial borings made, and I think it would pay. As for surface water, every year oceans of it goes away into the Sina and Bhima rivers. India has the largest rainfall of any country in the world and suffers most from famine; why cannot we catch the water in some way? In Southern India they store water in tanks; there the surface of the ground is more level than it is here; it is easier to take water out of rivers because the river beds are shallow; here it can be managed if dams are put across the Sina and Bhima river beds and the water turned off and stored in large tanks. I think the water could be used for irrigation, or, if not, it would raise the general water-level of the soil. Another scheme I have dreamed of for years is to put large dams across the Sahyadri or western range of mountains, put large dams in the valleys; there is a rainfall of 100 to 400 inches, and it is of no use to any body; the land is higher than most of the Deccan, and slopes to the east. Why cannot large tanks be made there? I am not an Engineer, but it seems to me something of that kind might answer. In Mahableshwar we have had 400 inches of rain, and I have seen places where a dam could be put and where an immense amount of water could be stored. There may be difficulties that I don't see. One Engineer told me that this water would not be very useful near the dams, because there is a pretty good rainfall every year, but I don't think that is a sufficient objection.

4. *Q.* Do you think that in a year of normal rainfall in this district the rayat would avail himself of canal water or water from the tanks?—I think he would.

5. *Q.* Would he take it for his staple dry crops?—He would take it for the crops he thought would pay best—*juari* or some other.

6. *Q.* There is no question, do you think, that the water would be disposed of?—I think not.

7. *Q.* Elsewhere, where there is heavy black cotton soil, we have been assured that the rayat will only under great extremity take water; the works you have suggested would fall on the tax-payer, and it is highly important that some water-rate be paid, not only once in a dozen years but every year?—From all I know of the people, I think they would be glad to take the water.

8. *Q.* (*Mr. Ibbetson.*)—They don't take water from existing tanks in ordinary years at present; that is one of the great difficulties here; why is that?—Government can answer that question better than I can.

9. *Q.* (*The President.*)—Mr. Beale, would you say that the evidence is conclusive that tank water is not availed of?

(*Mr. Beale.*)—I think so.

10. *Q.* (*Mr. Ibbetson.*)—Do you still think that water brought at this enormous cost would, in ordinary years, be used when the water that is there is not used?—The people seem anxious to take the water.

11. *Q.* Do they ever give reasons for not using the water that has been provided already at considerable cost?—I don't remember hearing any reasons.

12. *Q.* You didn't know the fact perhaps?—No.

13. *Q.* (*The President.*)—I suppose the fact is that in a normal year dry crops require very little more water than the heavens give?—Yes, but there are lands above the black soil which might require water.

14. *Q.* Take the Ekruk tank; do you think it commands any lands of that description?—Yes, black soil is sometimes found on high levels and sometimes on low levels, and between them you will find red soil or *muram* soil, which requires more water than black soil; you can raise anything on that, if you have plenty of water.

15. *Q.* From your intimate knowledge of the people, do you find that they appreciate the system of *takavi* and are glad to avail themselves of it?—I think so.

16. *Q.* Do you hear complaints of the formality to be gone through and of money sticking in the fingers of those it passes through?—Yes, I hear frequent complaints; the Patel and other underlings require their fee.

17. *Q.* Do the people go more readily to Government than to the *sowcar*?—I think they do.

18. *Q.* You have suggested that the Collector might have boring machinery for testing for sites for wells; have you any other suggestions to make which would accelerate the increase in the number of wells?—I don't think I have.

19. *Q.* Do you think the amount of interest—it is 5 per cent. in this Presidency—deters them?—I don't think that is too high. I think generally people would rather go to Government and deal with Government than with the *sowcars*, because the *sowcars* would try to get the fields into their own hands; they can trust the Government better than their own men.

20. *Q.* We have had complaints made of the rigidity of the Government payments; it is said they have to be made whatever the season is like, and that the *sowcar* is more or less pliable; what is your opinion?—I have found that these people always have something to complain of any way.

21. *Q.* You don't think they have reasonable grounds for complaint as regards that?—I have not that impression.

Mr. J. Mollison.

MR. J. MOLLISON, M.R.A.C., Inspector General of Agriculture in India.

(*Bijapur, 7th January 1902.*)

Note by witness on possibilities in the Deccan of extension of protective irrigation works.

The Deccan and parts of the Southern Mahratta Country are in greater need of protection by irrigation against drought than other parts of the Presidency. In my note already submitted to the Commission I have discussed at some length the value of wells in these least protected parts. I am aware that the well-irrigated area in the Deccan districts in 1900-01 was less than that of 1899-1900 by nearly 90,000 acres. This is attributable to failure of water-supply; the result of scant rainfall in the more open plains during four or five consecutive years. Good rainfall during one or two years will again raise the water-level and the well-irrigated area will again expand. If proper encouragement is given, there will be further expansion.

2. At Surat I suggested to the Commission one means of encouragement. I proposed that Government should offer a premium of Rs. 25 per acre of good crop produced in the first year between the 15th of October and the 1st of May by regular irrigation with sweet water from a *pakka* built well. The total amount per well should be limited to Rs. 100 where the depth is less than 30 feet and to Rs. 200 where deep and very costly wells are required. Nothing should be given for shallow wells with depth to water less than 18 feet.

3. I would post a notice signed by the Collector in every village in the unprotected parts of Gujerat, the Deccan, and the Southern Mahratta Country, stating that the object of offering the premium is to encourage the construction of wells in all favourable positions, so that there would be a means at hand for producing food for the people and their cattle in portions of all villages in famine years or in years of scant rainfall; and also of providing in these seasons remunerative work for some at least of the people. In the same notice, in order to allay suspicion of ulterior motives, an absolute pledge should be given that Government will not at any time raise the assessment on well-irrigated lands in any greater degree than on similarly assessed dry crop lands. The premium which I recommend should pass directly from the hands of the Collector, or one of his Assistants to the hands of the owner of the well.

4. In the unprotected parts of the Deccan I do not expect to see any very material increase of protection by new canal or large tank projects worked by the State. The supplies of water for existing canals can no doubt be increased by additional expenditure for storage. The Deccan generally lends itself unfavourably to any large system of canal irrigation, and such irrigation is not at present to any great extent protective for various reasons. The chief reasons are—

(i) that the surface of the Deccan is rolling and irregular and the soils which are especially suitable for irrigation except in open plains far from catchment areas occur to a large extent in patches;

(ii) that in order to command these patches the course of a canal near its head-work must be exceedingly tortuous. The canal must to a considerable extent be constructed through upland, light soil, *muram* and hard trap. The prime cost must, therefore, be large and the waste in leakage from the canal itself will be very great;

(iii) that the distributing water channels have often to be made long distances through light soil which is unsuitable for regular irrigation. As much water may leak from the distributing channels as reaches a field if it is a small isolated area of a few acres only;

(iv) that in years of drought existing canals fail to supply, when most urgently needed, sufficient water for the area of crops ordinarily commanded by them;

(v) that they are worked more for revenue than as protective works. Intensive perennial irrigation paying high rates on comparatively small area is encouraged. Water-logging to a serious extent has thereby been produced. It will get worse unless drainage is arranged for or a radical change made in the system of irrigation.

5. The intensive system of irrigation above referred to has produced extraordinary valuable crops of sugarcane in the Poona district. A class of speculator landlords rather than *boná fide* cultivators has been thereby enriched. Land of good class commanded by the canal has become exceedingly valuable. I take it that it was not the intention of Government that a canal designed as a productive work should be the means of enriching landowners who are not themselves cultivators and who, when the pinch of famine comes, accept little or no responsibility in providing food or work for starving people. This landlord class of people has been largely benefited by the Kharakwasla Canal and possibly also by the Nira Canal.

6. In encouraging the intensive system of canal irrigation above referred to, the irrigation officer pledges himself morally, if not actually, to give canal water throughout the year for the more valuable perennial crops which pay high rates. In a year of drought this pledge makes it impossible for him to give, to any considerable extent, water sufficient to save withering *kharif* crops. He must save sufficient water for irrigation in the hot weather of the following year. He will freely admit that it does not pay to give, at the ordinary rates, canal water to save a withering *kharif* crop. An enormous amount of water is certainly absorbed in the first watering by black soil which has dried and cracked. The owner of a *kharif* crop in a year of drought wants water, however, before the soil gets to this stage of dryness. He is prevented from getting water at the right time because a permit is necessary. He does not apply for a permit until he sees signs of his crop withering. He does not usually get it until his crop is past saving. During the last five years canal water has been used repeatedly to help or save withering *kharif* crops on the Government Farm at Kirkee. In the 1899 famine year three waterings were found necessary. The first watering was got in time. Formal sanction was afterwards obtained. An ordinary cultivator could not so easily have arranged with the Irrigation Department in sufficient time to save his crop. The actual outturn of grain and fodder at the Kirkee Farm from the irrigated crop referred to compared favourably with that of ordinary years and owing to high market-rates was worth about double as much as usual.

7. A cultivator knows perfectly well how valuable canal water would be in a year of drought in saving a crop which would otherwise wither; but if he is to take advantage, there must be no obstacles put in the way of his getting the water in time. I should therefore make him free to take the water during the *kharif* season without a day's delay when he wants it if it is running in the canal. I should safeguard the Irrigation Department as regards water-rates by compelling the cultivator under penalty to give information regarding his requirements on the date he begins to irrigate. He will not take water unless he urgently needs it. The expense of leading water over uneven land with no system of beds is considerable and the water-rate has to be paid.

8. I confidently believe that the Kharakwasla and Nira Canals, which are the most important irrigation works in the Deccan, would be much more protective than they are and would irrigate much larger areas than they do (*a*) if less water was saved for irrigation of perennial crops between the 1st April and the break of the next monsoon; (*b*) if more water was used during drought for *kharif* crops (*c*)

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if free scope is given for the irrigation of food grain and other crops between the middle of October and the 1st of April. I believe that higher rates than those now charged for *kharif* and *rabi* irrigation would be quite justified. But in any case, until experience and results are obtained, the question of revenue should be made subordinate to that of security against famine.

9. I am entirely against irrigation officers pledging themselves either morally or actually to give canal water for perennial crops between the 1st of April and the beginning of the rains in any year. I would rather be inclined to issue a year's notice to the present sugarcane growers and others to the effect that the Irrigation Department cannot guarantee in any year a supply of canal water for perennial crops between the 1st of April and the break of a favourable monsoon.

10. Within recent years many of the sugarcane crops grown under canal irrigation in the Poona districts have been exceedingly valuable and the superior holders or occupants of the land thus irrigated can very well afford to construct wells to irrigate their crop in the hot weather. The chances of getting water at reasonable depth are pretty certain and the wells if constructed will be a great safeguard during season of scant rainfall and will in all seasons be a mutual help to the canals.

11. Mr. Visvesvaraya has explained to me the block system of irrigation which he has proposed for canals in his charge. The system would, in my opinion, act excellently if he can get village communities to choose their areas, if each village community regulates the distribution of the water equally to the village block, and if perennial irrigation is restricted.

12. I do not think small tanks in the open plains of the Deccan will be of much use. They will not fill except in years of exceptional rainfall, and even if full in the rains, they will not hold water long during the fair season. Mr. Visvesvaraya proposes to have storage tanks along the course of a canal to be filled as required from the canal. The proposal is, I think, sound and could be made to fit in with his proposed block system of irrigation. Leakage from such tanks would help well irrigation. But it is very difficult to see how water-rates are to be arranged for this mutual support system unless a village community agree to pay a lump sum for a term of years for the irrigation advantages received. The community could apportion among themselves the amount which each occupant should pay. Theoretically there are great possibilities, but I do not quite see how it is all to work out smoothly in actual practice.

13. There is great scope for extension of irrigation by pât from *bandharas* throughout the Deccan. Extension of well and pât irrigation should be encouraged together. A complete survey regarding possibilities is required. Only practical experienced officers who can consult the people as to their requirements should be put in charge of such survey. The surveyor will determine where pât irrigation is practicable without infringing on down-stream rights. Having determined this point, village communities should be encouraged to undertake the work themselves. No charge for the water should be made for a term of five to ten years. Afterwards a very moderate lump sum for each *bandhara* should be charged. The people can make their own arrangement regarding apportionment. Government should also give an absolute pledge that the assessment of pât irrigated lands will at no time be raised higher than similarly assessed dry crop land.

14. I believe that if the people are encouraged to construct wells and *bandharas* throughout the Deccan in the manner I have sketched, a very full measure of protection against famine will be reached in a very few years.

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1. *Q.* (*The President.*)—We have received your paper and I have read it with a great deal of interest. I gather from it that you think the best means of protecting the country against famine is by wells and *bandharas*?—Precisely.

2. *Q.* Although it is a recognised fact that in times of prolonged drought the water in wells goes down considerably?—It certainly goes down, but I imagine that canal irrigation would go down to the same extent or even more. During the past 5 or 6 years, a worse condition of affairs has been experienced than usual. There have been a succession of famines since 1896-97, and notwithstanding that fact the wells have done comparatively well.

3. *Q.* You believe irrigation from canals has gone down equally?—Yes.

4. *Q.* Take the Nira Canal; has that gone down?—No; but the circumstances there are exceptional.

5. *Q.* What makes you say so?—The conditions on the Nira are most favourable. It is led away from a catchment valley in the Ghâts straight to land most favourable for irrigation.

6. *Q.* Is it the only valley of the sort available?—You could get land as favourable for irrigation in the open plains of Ahmadnagar, Sholapur and the Southern Maratha Country where similar conditions might develop, but not, in my judgment, so near the catchment area.

7. *Q.* You would have your canal leaking so that when you reached a good spot your water would be all gone?—That is an engineering question. I would like to see a thorough survey made.

8. *Q.* (*Mr. Ibbetson.*)—The loss of water that you refer to would be the same in all years; why should canal irrigation decrease in famine years?—The head-works would not fill in a famine year. The depth to water in a well is not much greater in a first famine year than in an ordinary year, and it is not much worse than an ordinary year in a second famine year; the supply of water in a well is safer than a supply of water in a canal.

9. *Q.* (*The President.*)—Is not the supply of water equally good in the Ghâts?—In the Ghâts catchments you get rain probably in a famine year, but even with this safeguard canals are not so protective as wells. On the Mutha Canal in the *kharif* season a good deal of water runs to waste in ordinary seasons. If good rain comes in October, the people freely apply for water for sugarcane; if the late rains are deficient, such applications are not freely made.

10. *Q.* That is, they anticipate that there will be a decrease in the canal supply. May it not be that there will be a greater demand for other crops?—They know it by experience. Cane is planted between December and the February following, and when the cultivator knows positively that the canal water-supply is sufficient, he is keen to apply for water for cane. If there is deficient supply no cane is grown.

11. *Q.* (*The President.*)—May not the bad supply for cane arise from the greater demand for other crops rather than from a less actual supply of water. Perhaps Mr. Beale can tell us.

Mr. Beale.—The Kharakwasla always fails; but irrigation in the hot weather depends on the balance in the tank and that depends on the late rains; if these are good less water is used for *rabi*, and there is more to spare in the hot weather.

12. *Q.* (*The President.*)—In paragraphs 2 and 3 you suggest a plan for encouraging well irrigation by giving premiums on good crops. Would it not answer the purpose equally well to give money for wells?—If no interest is charged much encouragement would result.

13. *Q.* In paragraph 4 you say—"The Deccan generally lends itself unfavourably to any large system of canal irrigation, and such irrigation is not at present to any great extent protective for various reasons." Then you go on to give five reasons for it. All these objections are financial. It would cost more to get the water on to the land?—It is a question of cost per unit of supply. There are no physical impossibilities.

14. *Q.* You mean that there are no physical impossibilities, but that it is merely a question of whether it will pay?—It is only a matter of money.

15. *Q.* (*Mr. Higham.*)—You think the money could be spent better in another way?—Yes; I think, if the money were spent on wells, it would go further. Canals cost Rs. 200 an acre irrigated. We could do a good deal with that capital in extending well irrigation and do more good.

16. *Q.* (*The President.*)—Then you mean to say that the canals are worked more for revenue than as public works. That is an administrative matter. Government might arrange their working as it pleases. I mean it is in the power of Government to say that the canal must be worked in this way or that?—Yes, but definite orders one way or the other should be issued to the Canal officers.

17. *Q.* You say "a cultivator knows perfectly well how valuable canal water would be in a year of drought in saving a crop which might otherwise wither. I should,

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therefore, make it free to him to water during the *kharif* season without a moment's delay." Would he not understand that water could be taken when necessary? I thought that Mr. Visvesvaraya told us the application in the monsoon was done away with?—Water is not given without application. Proposals have been made to give definite supplies of water for particular blocks of land in particular villages. Mr. Visvesvaraya has proposed, I believe, some such system.

Mr. Ibbetson.—Yes, but I believe the relaxation is limited.

The President.—That again, of course, is not a matter inherent in the canal. It is a question of administration.

18. *Q.* I do not quite understand Mr. Visvesvaraya's "block" system; can you tell us something about it?—He proposes to guarantee water to 200 or 300 acres per village and restrict the irrigation of perennial crops in those areas, so that a good deal of water will be available for *rabi* crops.

19. *Q.* Then does he propose that the village should confine itself to irrigate this area?—He calculates how much water he can dispense and distributes the water among certain villages; he leaves the cultivators free to divide the water among themselves. He thinks in that way the cultivators will make better use of the water.

20. *Q.* But he takes it upon himself to say how far the water should go. He does not leave it to the cultivator?—He believes that this system will economise the water.

21. *Q.* Yes, but supposing a cultivator under this system had water for 10 acres guaranteed to him, would he let him distribute it over 15 acres if he wished to do so?—He gives the village a certain quantity of water and leaves it to the cultivators to distribute the water among themselves. He has no objection to their using the water on an increased area.

22. *Q.* You say "I do not think that small tanks in the open plains of the Deccan will be of much use. They will not fill in the rains except in years of exceptional rainfall, and even if full in the rains, they will not hold water long in the fair season." Is that so in Gujerat also?—That does not apply to Gujerat but to the Deccan, where there is excessive leakage through *muram* and trap.

23. *Q.* (*Mr. Ibbetson.*)—The rainfall in the Deccan is small and uncertain?—Yes; scantier and more uncertain than in Gujerat.

24. *Q.* (*The President.*)—Then you go on to the question of *bandharas* irrigation. You presume in that case that there is water in the rivers?—I know that there is water in the streams which could be utilized.

25. *Q.* Has the Government opposed the use of water from the *bandharas*?—The Government has opposed it in a sense, because if the cultivator takes the water he has got to pay for it; I would do away with the whole system of charging for the use of water from *nalas* and subsoil water everywhere.

26. *Q.* It comes to this. You think that it belongs to the riverain population and not to the population at large?—You give it free for men and cattle to drink and you refuse it to the thirsty land. I would only charge where Government incurs the cost of the *bandharas*.

27. *Q.* (*Mr. Ibbetson.*)—In the Deccan only or everywhere?—Everywhere.

28. *Q.* (*The President.*)—You say "I believe that if the people are encouraged to construct wells and *bandharas* throughout the Deccan, in the manner I have sketched, a very full measure of protection against famine will be reached in a very few years." If that were carried out to the fullest extent, could you give any idea as to the amount of cultivated crops we might be expect to see under irrigation in a bad year?—The present area under *bandharas* is trivial; the well-irrigated area is about 700,000 acres. It might in time be doubled.

29. *Q.* But the cultivable area of the Deccan is 20,000,000 acres?—Ninety per cent. of the cultivable area is unsuitable for irrigation. There are many uplands where the soil is too thin and rocky.

30. *Q.* (*Mr. Ibbetson.*)—Too rolling?—Yes. I won't commit myself to 90 per cent. If you have 1½ millions of acres under wells, this would be the pick of the land of the Deccan and the difference of outturn will be considerable. We would be concentrating our efforts on the best part of the country—the pick of the land—which will produce 4 to 6 times as much as poor soil even without water; add water and you would still further increase this.

31. *Q.* Would you not store water?—Yes; canals from stored water would help well irrigation by keeping up the water level. In the case of a *bandhara* with a little storage a man would probably protect himself further by building a well.

32. *Q.* Would you store the water that falls in the hills every year or would you let it flow away?—That is an engineering question. The Engineers can decide whether storage is required. I have not the experience to offer an opinion.

33. *Q.* (*Mr. Higham.*)—I understand that you deprecate canal irrigation in the Deccan?—Yes; I prefer well to canal irrigation and preferably would like to see well irrigation extended.

34. *Q.* Although you have an enormous rainfall in the Ghâts, no efforts have been made to utilize it for irrigation in the Deccan?—You would do quite as much good by spending the money that it would cost to bring the water down in making wells.

35. *Q.* Have you worked it out in any way?—Yes; I think well irrigation is cheaper. A canal costs Rs. 200 an acre, and that amount would go a long way in extending irrigation by wells.

36. *Q.* How many acres would you irrigate for the Rs. 200 applied to the construction of a well?—A Deccan well working 2 *mots* would irrigate 6 or 7 acres and would cost from Rs. 300 to Rs. 400.

37. *Q.* (*The President.*)—In Sholapur we were told that wells cost a good deal more than that.

38. *Q.* (*Mr Ibbetson.*)—You refer to a *kachcha* well?—A *kachcha* well in the Deccan is built so well that the sum necessary to complete it is not a great deal.

39. *Q* (*Mr. Muir-Mackenzie.*)—Would you say that such a well would last for an indefinite period?—*Kachcha* wells in Gujerat fall in with rain; but in the Deccan, where the base is rock, it only requires masonry built up on one side for the *mot*, and a well so constructed may last indefinitely.

40. *Q.* What is the area in the whole of the Deccan which could be protected by wells?—At present the maximum area is 700,000, but I should be extremely glad to see the present area doubled. 1400,000 acres is the limit of possibility in my opinion.

41. *Q.* (*Mr. Ibbetson.*)—The present area is only about 2 per cent. of the Deccan?—I should say not more than 2 or 2½ per cent.

42. *Q.* (*Mr. Higham.*)—If you double that it gives only 5 per cent.; that won't keep famine off?—The land thus irrigated from wells would be the best land and would give an outturn of great value in a famine year, and very valuable crops in ordinary years.

43. *Q.* What about the other lands?—The outturn from the uplands on an average is extremely poor.

44. *Q.* In order to get more than 5 per cent. something more will have to be done. Wells will not afford full protection; what else do you propose?—I have no objection to canals so long as you do not mind the cost and regulate the distribution so as not to damage the land. A lot of land irrigated by the canals in Poona is going out of cultivation, because it gets excessive irrigation. Give a man a well and you will find that his land will not go out of cultivation.

45. *Q.* Why do you limit the possibilities of wells to 1,400,000 acres?—The area of low-lying lands with 2 to 4 feet of black soil and *muram* below limits the increase. I don't think favourable positions for wells other than these can be found. You can put too many wells together in a small area, one well drawing on the supply of another. They must be distributed.

46. *Q.* (*The President.*)—How far apart should they be? Would you say 10 acres to a well?—I think that two wells in the most favourable positions might be put in 10 acres, but it depends on the slope and the catchment. In Junnar and Khed (Poona district) two wells in 10 acres would be perfectly safe.

47. *Q.* (*Mr. Higham.*)—You are afraid that wherever canal irrigation is introduced the result will be the growth of perennial crops by wealthy capitalists and not much protection to the population generally?—That depends on the orders of Government. If left to the Irrigation Department as at present, I don't think there is any likelihood of a charge in the system. They attempt to work the canal more for revenue than for protection.

48. *Q.* The Nira Canal is not worked for revenue; the percentage of cane cultivation is only 8 per cent.?—It will extend as the men get richer.

49. *Q.* It is kept down artificially by conserving the water for *rabi* crops?—It is left to the option of the controlling officer.

50. *Q.* Surely an acre of cane irrigation has great protective value, whether in the hands of capitalist or cultivator, than an acre of dry crop. Supposing you had lots of manure, could you increase the area?—I showed you at Manjhri the extreme limit to which cane cultivation can be got with suitable soil, manure, and water. It is possible to get sugarcane crops under favourable conditions worth Rs. 1,000 per acre which would give 12,000 or 13,000 lbs. of *gur*.

51. *Q.* How much of that is the value of manure?—Rs. 200 an acre.

52. *Q.* The purchase of that manure must maintain a good many people?—Yes.

53. *Q.* So that altogether an acre of cane will maintain 4 or 5 more people than an acre of *juari*?—Yes; but for perennial irrigation it is required that a good deal of water should be stored up, so that water can be given in the hot weather. That makes it impossible for irrigation to be given freely in the monsoon. Therefore, in a year of drought, the crops in that particular year absolutely wither, because a pledge has been given by the irrigation officer for a portion of the water nine months ahead.

54. *Q.* That would not be so if the cane crop was limited to a certain area? —The limit, I propose, is that those richer capitalists who grow sugarcane should be given water from the canal only if they have a well. If they can afford to buy manure and can afford the other expenses necessary for growing a good crop of cane, they can equally well afford to dig their own wells.

55. *Q.* Supposing you made a condition that before sanctioning perennial crop irrigation in any holding a well should be constructed, would that prevent the full utilization of canal water in the case of a new area?—I do not think that in the sugarcane area of Poona it would have any deterring effect, but with new areas it would limit the utilization of the canal supply.

56. *Q.* I am not speaking of a deterring effect. If he made his well, we should not reserve water for him in the hot months?—That is all very well now; but suppose we had a new work and you said I will not give water unless you have a well, the man might not grow sugarcane at all.

57. *Q.* From your point of view that is what you want? —What I object to is that so much water is taken up in a year of drought and not given to ordinary food-grain crops.

58. *Q.* The only practical remedy for that seems to be to have no canals at all or to say that perennial crops must be partially protected by wells?—I have no objection to that.

59. *Q.* You think that in a new work no one would go in for irrigation on those conditions?—Yes; but in the case of established works the men being capitalists, they can afford to build a well in order to continue this profitable perennial cultivation.

60. *Q.* Of course one point has to be remembered; it is all very well to talk of working a canal for revenue. But there is a limit to money that can be spent without any hope of return; and that if any portion of that expenditure will bring a return, you will have more money to spend elsewhere; supposing the limit of expenditure of your purely protective works was 100 lakhs, if you can get a return of 20 per cent., then you can afford to spend 20 lakhs more on the works?—That is true; but it would be better to spend the money on wells.

61. *Q.* (*The President.*)—Why should not a man go in for a well for sugarcane on a canal as well as off a canal; you say that off a canal his land is used for other crops; would it not be a greater recommendation for *takavi* if he can go in for sugarcane?—In ordinary seasons he does grow sugarcane on his well, but in a famine year he changes his system and grows fodder and food-grains.

62. *Q.* I do not see, where a man applies for *takavi* and goes to the expense of digging a well, why he should not do it if there is the extra inducement of canal irrigation to assist him in irrigation. Why do you say that he will not come forward?—I did not say that he will not come forward; I said he might not.

63. *Q.* (*Mr. Ibbetson.*)—With reference to what you have just said about a man who had a well changing his system in a year of drought, it would be just the same if a man grows cane on a well; he could not afford to let the cane go in order to water his other crops during the monsoon?—The result in the Kaira district and generally throughout the Deccan was that all ordinary market garden crops were given up in favour of fodder and *juari* in 1896-97 and in the last famine, and there was an enormous yield of fodder in consequence.

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64. *Q.* By "given up" you merely mean that they were not planted?—Yes, garden crops were not grown.

65. *Q.* It would be exactly the same on a canal. In a year of drought the people would prefer to grow fodder instead of garden crops?—Yes; that happens on the Mutha canal.

66. *Q.* Then so far there is no difference between canal and wells; the change of crop takes place equally on both?—The proportionate area of garden crops under canals as compared with cane is much smaller than under wells.

67. *Q.* Now, so far as cane goes, is not the well-owner as much bound to give water to his cane as the canal irrigator?—Cane pledges water for a longer period than garden crops and the cane area is less under wells than under canals.

68. *Q.* You are arguing almost entirely from the Kharakwasla. Are not the conditions exceptional there? There you have an enormous city with rich manure, land close by, and wealthy capitalists who can easily keep an eye upon their investments. Do you think the state of affairs that exists near Poona would spring up if you had the canal far from the city?—The Mutha Canal is a special work; the conditions on other works would not be so marked.

69. *Q.* How about wells close to Poona; would they irrigate a larger proportion of cane than wells elsewhere?—Yes, probably; but cane cultivators prefer to use canal water, paying for it Rs. 50 per acre. They use their wells only in the hot weather when the canal supply is intermittent.

70. *Q.* (*Mr. Higham.*)—What is the average percentage of cane under wells?—It is very trivial.

71. *Q.* If a man has 4 acres, how much of that would be cane?—A fraction of an acre, possibly.

72. *Q.* (*Mr. Ibbetson.*)—Is the proportion of cane grown under wells in the Deccan smaller than in Gujerat?—Yes, probably.

73. *Q.* Your impression is that it is smaller in the Deccan?—Yes.

74. *Q.* As to your preference for wells over canals, you have described the conditions under which wells can be made and worked profitably; and you have also told us of a large area in which irrigation cannot be used profitably. Is there not a considerable intermediate area in which wells cannot be made, but which would be worth protecting by irrigation?—The areas of this class uncommanded by wells are very considerable in Ahmadnagar, Sholapur, and the Southern Mahratta Country. These uplands might be worth protecting.

75. *Q.* So that there is a considerable portion which you cannot protect by wells but which can be protected by canals?—The manure question would then come in. It would be a very serious consideration. There is a limit to extension on account of the supply of manure.

76. *Q.* All that means is, that protection by irrigation from wells is to be preferred because it is slower than canal irrigation?—I think the irrigation of lands manured under wells is more efficient than under canals. Regular irrigation is given instead of heavy waterings once in eight days as is the case with canals. By heavy waterings from the canal the manure is swept away and the soil becomes water-logged.

77. *Q.* So that as regards that area which can be protected but in which wells cannot be made, your main objections are the fear of the failure of the manure-supply, the risk of water-logging, and the consequent salt efflorescence?—Yes, unless the system of canal irrigation is improved.

78. *Q.* I quite see the danger of water-logging in Gujerat; but with a shallow black soil with *muram* underneath, would there be the same danger of water-logging?—Even with *muram* below I have seen water-logging in the lower lying areas commanded by canal irrigation. This is due to direct leakage from the canal, and the drainage from over-irrigated high lands to lands lying at a lower level. The result of this leakage may be seen in every *nala* on the G. I. P. near the Mutha Canal.

79. *Q.* It is not so much the irrigation as the leakage in transit that you fear?—Yes; the loss is enormous;

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80. *Q.* The loss of course is a mere matter of money; the water-logging is not. Supposing that you kept all canal channels full, but did not put water on the land, would the leakage from the canal keep the *nalas* running? I want to know how much of this leakage is due to irrigation and how much to loss from the canal?—The *nalas* were usually dry in the fair season before the canals were made. Now they are perennial. The most serious loss is from water-logging.

81. *Q.* It is the actual irrigation you are afraid of then?—The leakage from the channels is much less than from the irrigated area. At the same time I would like to state that Poona City is said to be water-logged since the canal was made. I know an instance of a well in the compound of the bungalow of the President of the Poona Muncipality which cost Rs. 5,000, where the water level was formerly forty feet below the surface and it now stands fifteen feet from the surface.

82. *Q.* I want to get you away from Poona, if possible. The comparison between Poona and the ordinary canal is not satisfactory; let us go into the villages. Is there much water-logging on the Nira Canal?—No. The disadvantages produced by water-logging are compared with the great advantages the canal has brought. I went through the valley in 1896-97 and found it green throughout. The advantages of irrigation there are great. I noticed very slight evidences of waste of water and of salt efflorescence.

83. *Q.* Nothing to constitute a material drawback to the advantages accruing from the canal?—No.

84. *Q.* You say that the *nalas* run with water leakage from the canal. Does not that show that there is a very effective natural system of drainage?—Yes, that is so; but the railway often interferes with the free flow-off.

The President.—We have heard that stated by several witnesses wherever we have gone.

85. *Q.* (*Mr. Ibbetson.*)—I should like to have your opinion as to how far it would be safe to apply a strong artificial stimulus to the construction of wells. We are told that many wells made in the famine of 1896-97 are lying disused, and that many of those made in the last famine will not be used again, and that so long as a man has capital only will he work his well. Would there not be the danger, if you stimulate well work too much, of the people completing them for the sake of the bounty?—There is no doubt that the people have had a very great knock. During the last five dry years the wells did not give a proper measure of their use. I do not think that there will be any risk in stimulating the construction of wells to the fullest extent. After two years of good rainfall the people will come forward. They will not, I feel sure, want to go too fast.

86. *Q.* You do not think you would outrun the manure supply?—I do not think there will be any risk of that.

87. *Q.* You don't think people would make wells who could not afford to use them in ordinary years?—No.

88. *Q.* I take it that in the Deccan and Gujerat a man cannot afford to work a well in ordinary years except for high class crops?—The actual rate of working a single *mot* well exceeds Rs. 100 per acre.

89. *Q.* You object to canals because their protection is absorbed by wealthy capitalists. Is not that very much the case in regard to wells also?—It is often the case in a time of famine, if the well is a good one, for a number of families to club together. They each supply a proportion of the labour and of the manure and each participates in the profit. This system of co-operation keeps the owner's own family and the others who work under the well off relief work.

90. *Q.* That is that a man will share well water with his friends?—In Kaira in 1899 and in Ahmadnagar in 1896-97 that did occur in certain parts.

91. *Q.* We were told yesterday in Bijapur that such a thing was unknown. What is to prevent the people from doing the same with canals?—Because in my experience the wealthy land owner, when the pinch of famine comes, throws his responsibilities regarding the maintenance of servants, etc., on to Government.

92. *Q.* With reference to the working of canals on protective rather than productive lines, to refuse water to cane in ordinary years would mean that the water would go unused?—Yes, the water would probably go unused during the monsoon.

93. *Q.* Would the people use it for dry crops?—Yes, a good deal for the *rabi* crops.

94. *Q.* They would wait to see first in an ordinary year if there is going to be a good rainfall?—Yes.

95. *Q.* At any rate much of the supply would be wasted?—The water could all be used up for *rabi* and garden crops.

96. *Q.* You believe that if we brought the canal into a suitable tract, we could get all our water used for *rabi* irrigation, wheat, *juari*, etc.?—Yes, these food-grain crops and for market garden crops, such as onions, sweet potatoes, etc., occupying the ground between October and March. The water would be used for ordinary *rabi* crops not for perennial crops.

97. *Q.* Everything but sugarcane?—Yes.

98. *Q.* You think they would use all the water in ordinary years?—Yes.

99. *Q.* Supposing you found that they did not, would you then refuse to supply water to a crop of vegetables or cane because you thought the monsoon might fail?—I would refuse water if there was a chance of a bad monsoon in the coming season.

100. *Q.* If you could not use all your water on other crops, would you then give it to cane?—After meeting the demands of the other crops I would give the balance to sugarcane.

101. *Q* Now with reference to the royalty Government takes on water used, in the case of the Deccan, I quite agree with you. But in Gujorat where only two famines have occurred in 100 years, and where therefore the danger of scarcity is small, do you not think that it is reasonable that Government should take a small contribution for the water used?—Yes, perhaps in Gujerat, but I would certainly exclude the Panch Mahals and other parts where the people are poor and it is advisable to encourage irrigation in every possible way.

102. *Q.* If I exclude all insecure tracts, would there be anything unreasonable then?—For insecure tracts I consider that no water-tax should be raised.

103 *Q.* I am assuming that the principle is accepted in regard to tracts in which relief is commonly needed? - I agree that Government can easily collect a royalty on water in secure tracts without causing hardship, but in Bombay it is not worth while differentiating between tracts which are secure and those which are not.

104. *Q.* You say a Deccan well can be made for Rs. 300 or Rs. 400; is that a fair average?—For a well of a depth of 25 to 30 feet that is a fair average. The expense in making a *pakka* well is not much more than Rs. 400. Where there is soft soil to some depth the lining would be more expensive. But where there is 3 feet of black soil, then hard *muram*, and finally trap rock, Rs. 400 is a fair average price.

105. *Q.* Do you mean to say that such a well would last indefinitely?—I think so.

106. *Q.* Then why does a cultivator ever go to double the expense?—If the land is alluvial the well has to be deeper.

107. *Q.* In the Deccan?—Yes.

108. *Q* Why do the people go to the expense of making a *pakka* well when a *kachcha* well such as you describe lasts for ever?—*Kachcha* wells which last for a long time are found only where the sub-strata are hard and durable. Many such wells are found throughout the Deccan.

109. *Q.* Are *pakka* wells built with stone and mortar throughout?—Yes, when black soil is deep it is necessary to line them.

110. *Q.* (*Mr. Muir-Mackenzie.*)—Are the majority of wells you know in the Deccan lined or not lined?—A great many are built up only on the *mot* side.

111. *Q.* (*Mr. Ibbetson.*)—Now, Mr. Mollison, you were good enough at my request to look at the irrigation in the north of India, and to make inquiries regarding the differences which exist between the extensive canal and well irrigation as practised in the Punjab and North-West Provinces and the intensive system as practised in Bombay. Would you kindly tell us what is, to your mind, the main difference between the two systems?—A vast area in the North-West Provinces and the Punjab is commanded by the Ganges and Jumna systems of canal irrigation and by deep and shallow wells in parts where the canal distributing channels do not reach. The ordinary cropped area consists of very deep alluvial soil of very fine consistence and of great natural fertility. The character of this soil is such that after irrigation moisture is retained near the surface

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for a considerable period. This retentive quality is helped by copious deposition of dew throughout the cold weather, and probably the atmosphere in the north of India at this particular season is not nearly so absorptive of soil moisture as in the more southern parts. The practical effect is that a first watering given from a canal or well softens the soil, so that preparatory tillage for a *rabi* crop or for an early sown *kharif* crop is facilitated. The moisture remains in the soil until tillage is complete, the seed is sown, and satisfactory germination has occurred. Subsequently two waterings from a canal or three or four from a well is sufficient to bring a *rabi* wheat crop to maturity. This crop mixed with rapeseed or gram is the chief *rabi* crop grown. The total cost of leading the water over the field for the first watering, in laying out beds for irrigation, and in applying the water is very trivial. It does not exceed 8 annas per acre. The distributing channels are made of puddled soil. They allow no leakage of water. The surface of the fields is even; the water in large volume is easily distributed; therefore the cost of the first watering is small. The villagers have the usual number of work and breeding cattle and milk buffaloes of any ordinary district. The dung of cattle, the litter and the household waste is carefully preserved. The manure heap which each occupant thus accumulates provides the only manure applied to the irrigated fields. It is a very light dressing; owing to the character of the soil and lightness of the irrigation, this light dressing of manure on an irrigated crop is quite as effective as if the soil was kept moist by timely showers of rain. There is no difference in effect whether the irrigation is by flow or lift from canals or by lift from deep, medium or shallow wells. The contrast between this system of irrigation and cultivation and that necessarily practised in the Bombay Presidency is very pronounced. Medium black soil with *muram* below (the best black soil to irrigate in the Deccan) dries so quickly between waterings that irrigation is required every 8 to 10 days. The *goradu* (sandy loam) soils of Northern Gujerat are so absorptive and dry so quickly that irrigation is required in the fair season every five or six days. Such irrigation is exceedingly expensive from wells owing to the cost of raising water. Heavy dressings of manure are required on the limited areas irrigated because owing to cost of lifting water only very good crops will pay. A really good crop can only be produced from good soil by regular irrigation and heavy dressings of manure. Unfortunately the heavy and continuous irrigation washes much of this manure into the subsoil and the crop only takes up a certain proportion. With this intensive system of irrigation a single *mot* or *kos* (leather bag) will only lift water from the deep wells of Gujerat for an area of about two acres and from the shallower wells of the Deccan for an area of three and a half to four acres. In the Hissar, Delhi, and Rohtak districts of the Punjab I have seen deep, medium and shallow wells at work. I have found deep wells, the masonry construction of which extended to a depth of 110 feet, with depth to water of 60 to 70 feet, irrigating each six acres of wheat or barley; medium depth wells, 30 to 40 feet deep, irrigating 8 or 10 acres per leather bag, and on the riverain land, wells with 20 feet depth to water irrigating 12 to 14 acres each. The very deep wells were this year worked very hard because the *kharif* crops owing to deficient rainfall failed, and there being no means of canal irrigation the people depended upon the wells. Relatives or families joined together to participate in the profits of irrigation, jointly finding all the manure and labour required to produce the best results. The same practice occurs in the Deccan and Gujerat in a famine year. The natural fertility of the Ganges-Jumna alluvial soils may to some extent be gauged by the fact that on soil of this class in the Cawnpore Government Farm irrigated wheat has been grown since 1881 without manure and the crop of 1900 yielded, approximately, of grain per acre 1,200 lbs. from one plot and 1,400 lbs. from another. It may also be gauged to some extent by the fact that in the Hissar district in the current year (a season of unfavourable rainfall) land irrigable by lift from the canal is freely rented out at Rs. 15 per acre for the year or at Rs. 10 to Rs. 11 per acre for one crop. Tenants pay in addition all irrigation charges. The canal water is only lifted a few feet and irrigation therefore is not costly. In the same district I found land irrigated from a well with depth to water about 60 feet rented at Rs. 8 per acre. It is not unusual to take a *kharif* as well as a *rabi* irrigated crop in one season under canal irrigation, but it is more common to depend upon one good *rabi* irrigated crop or in a year of favourable rainfall on one good dry crop only. If the latter requires to be once irrigated to bring it properly to maturity, the charges for canal irrigation is 12 annas per acre and, as already stated, the cost of applying the water is trivial or negligible. The rates for canal water in the district inspected vary up to Rs. 5 per acre for sugarcane, Rs. 2-8 for wheat, 12 annas for a single watering, and half rates for water lifted from canal. I considered that approximately accurate outturns were more freely admitted by the actual cultivators than in Bombay; and from data communicated, I believe that the grain from an acre of canal irrigated wheat crop would ordinarily exceed Rs. 30 per acre, and of well irrigated crops considerably more. In the case of canal irrigated land excluding cost of light dressings of manure (the actual value of which can only be approximated) other expenses including assessment could not possibly exceed Rs. 16 or Rs. 17 per acre. The only risk is damage by rust, and that is inconsiderable.

112. *Q*. Gujerat is essentially a monsoon or *kharif* crop country; is it not, except for cotton?—Yes, except for the extensive wheat and cotton crops in Ahmadabad and Broach; Gujerat is a *kharif* province.

113. *Q*. Putting aside the wheat and cotton tracts the whole of the remainder is *kharif*? —Yes.

114. *Q*. On the other hand, the Deccan, broadly speaking, is a *rabi* province?—Those parts of the Deccan and Southern Mahratta lying inland and some distance from the Ghâts are chiefly *rabi*. The western talukas of Poona, Nasik, and Khandesh are chiefly *kharif*. In the eastern black soil parts of Dharwar crops of cotton and *juar* are sown between the two monsoons.

115. *Q*. What period is that?—In Dharwar cotton can be sown in September or as late as October, as it gets the north-east monsoon.

116. *Q*. Can you give me any broad reason as to why one province is *kharif* and the other *rabi?*—It is entirely a question of rainfall. In Sholapur and Nagar and the eastern talukas of Poona the important rain is the late or *rabi* rain. The character of the soil is such that if you have a good late rainfall, the *rabi* crop grows particularly well. In Sholapur and Ahmadnagar with heavy October rain there is a good *juari* crop.

117. *Q*. Except in the tracts under the Ghâts, I suppose very little rice is grown in the Deccan?—Practically no rice is grown in the Deccan, except under the Ghâts, but some is grown in the western talukas of Belgaum and Dharwar.

118. *Q*. I suppose that is because the rain is lighter and the soil is not suitable?—In the Ghâts there is a rainfall of 150 inches more or less, which rapidly diminishes till it is only 30 inches in Poona and 20 at Ahmadnagar. The rainfall is small away from the Ghâts.

119. *Q*. That explains the absence of small tanks?—Yes; they would not fill.

120. *Q*. We are told that people here will not take water from a tank because they only get it for a certain portion of the year. They have the idea that if a dry crop is given water once, you must go on giving it water. Does that feeling exist and is it based on any reason?—I doubt if those are the true facts. I should put the refusal to take water down to various reasons. The soil may be unsuitable; the tank may not fill well; the occupants of land under the tank may not be good cultivators. When water is refused from a tank, I should say previous inquiry before the tank was built, if properly conducted, would have accounted for it.

121. *Q*. You are far away from my point. Take the case of a canal, well established, irrigating sugarcane and garden crops; in a year of drought the water will be used for dry crops, but in ordinary years the cultivators would refuse to take water for them because he is not guaranteed a supply throughout the season. Do you think in a tank supplied from a permanent source we should find the same difficulty in disposing of the water?—I should say there would be.

122. *Q*. If we could get the supply from a permanent source, would the people begin to use water in ordinary years for dry crops; supposing there was plenty of water, more than they could use for first class crops?—In the case of a tank containing perennial storage I doubt if the water would be used even if the supply is guaranteed. For *jauri* only one watering is required and the cost of leading the water up to the fields is considerable and would have a deterrent effect.

123. *Q*. Yes; but if from the same cut he could get several waterings, is he likely to use the water?—For one watering it costs Rs. 4 to Rs. 5 for making channels.

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124. *Q.* Though the cost would be the same whether he took one watering or half a dozen?—He would rather have one watering.

125. *Q.* You don't think that on a tank where the supply is liable to failure, the people could be induced to use the water by making the supply permanent instead of uncertain?—I don't think there would be much difference as regards their taking water from a tank with a limited or a permanent supply.

126. *Q.* Supposing you have a canal, with plenty of water and a permanent supply assured, which commands a large cultivable area, what would be the maximum proportion of high class crops likely to be grown on an ordinary Deccan tract, supposing that you have manure and labour?—Probably not more than $\frac{1}{8}$th would be high class crops in an ordinary Deccan tract.

127. *Q.* You told us in Gujerat that one *mot* on an ordinary well would irrigate 2 to $2\frac{1}{2}$ acres in ordinary years or twice that in bad years if the water lasted out, would the same figures apply to the Deccan?—With Deccan wells $3\frac{1}{2}$ to 4 acres may be irrigated at one time. The area, however, would not be doubled in a bad year, but would be increased.

128. *Q.* You would not double the area in the Deccan in a dry year?—No; the water in the deep alluvial wells of Gujerat does not sink soon. In the Deccan the wells sink sooner than in Gujerat.

129. *Q.* Many of your best well tracts are in black soil; is the black soil more than 3 feet deep in the Deccan?—The black soil is 3 feet or 4 feet at the most. At this depth it can be irrigated. If it is deeper the soil deteriorates with watering. As a matter of fact, there is loss on wells in such lands.

130. *Q.* Can you tell us the cost of repairing a well in the Deccan?—I cannot give the figures. The people do not have to do much in the way of repairs besides silt clearance, etc.

131. *Q.* A well does not need much repairs?—No.

132. *Q.* You speak in your note of the rayat being prevented from using canal water when the crop is in danger of droguht owing to permission to take water being necessary. Have you seen the results of this at any time? Have you any personal knowledge on the subject?—Yes, I have seen the results at Poona near our farm. In 1899 the people did not apply for water till they actually saw their crops withering; then they applied for water, but could not get the permission in time to save their crops. On the Kirkee Farm we had a *kharif* crop and three waterings were found necessary. We wanted a first watering at once and we took it, formal sanction being obtained afterwards. The crops grown compared favourably with those of ordinary years and as market rates were high were worth double as much as usual, while all the crops round about perished.

133. *Q.* (*Mr. Muir-Mackenzie.*)—Do I understand that you got the water before you got the sanction?—Yes; if we had waited for the permit the farm crop would have been past saving. We got the water by arrangement with the Canal Department and got the formal sanction afterwards.

134. (*Mr. Ibbetson.*)—I understand that you know, as a fact, that other people did apply for water, but were so late in getting the permit that the crops died?—Yes, that is so; but they waited till the last minute before applying.

135. *Q.* As to your proposal not to give canal water for cane unless a man digs a well; is it not waste of water to give canal irrigation to a field already protected by a well?—The profits from canal irrigation are found greater in the case of expensive crops than from wells, so the cultivator takes canal water for nine months and uses his well for the remaining three.

136. *Q.* But why allow him to do so? The area he can cultivate is limited by the capacity of the well, so that he can irrigate it from the well all the year round?—I should like to see it done in the new canals.

137. *Q.* These *bandharas* which you recommend to be extended; would you build masonry dams or would you allow the people to build *kachcha* dams and let them be washed away in the monsoons?—I would let them build them as they like. Big *bandharas* built with masonry would be more substantial.

138. *Q.* If Government built the *bandharas*, it would charge for the water of course?—Yes.

139. *Q.* Do you think the people will begin with *kachcha bandharas* first and when they get used to them they will build *pakka* ones?—Yes; Government might build the *pakka* ones, but there would be no necessity for this if Government do not charge for the water.

140. *Q.* You propose that the water should be given free of charge?—Yes; I would like to see each taluka carefully and thoroughly surveyed. Any costs incurred in surveying might, I think, be charged to the cultivators.

141. *Q.* If all the *bandharas* possible were made, would they irrigate anything like the area commanded by wells?—The area under *bandharas* would be small compared with the area under wells.

142. *Q.* (*Mr. Muir-Mackenzie.*)—Do you think that money could be usefully spent in extending the number of *tals*?—I really have not sufficient experience of *tals* to give an opinion. You ought to accept local experience in preference to mine.

143. *Q.* In Ahmadnagar did you notice whether the land behind the *tals* had given crops?—I did not notice them particularly.

MADRAS.

General J. F. **Fischer**, R.E.

(*Bangalore, 18th January 1902.*)

[*Note.*—The numbering of the paragraphs refers to the list of printed questions for Revenue Officers.]

Before replying to these questions, I beg to promise that it is impossible to answer them fully without official records, data, etc., as regards rainfall, cultivation of lands, and many other points. I am therefore competent to give only general impressions from experience and recollections. In reference to hydraulic works generally, it is absolutely necessary to have the registers of rainfall for as many years as possible in every district, or every taluk, exhibited, so as to show the fall of rain in each month of the year; and this, of course, I have not the means of doing at hand. The records of the observatory at Madras will give a very fair idea of the rainfall for the coast districts, and these can be compared with any local registers.

A.—General.

1. My answers refer generally to the districts of the Madras Presidency in which I have served; for two years I was in the Central Provinces on irrigation works of some importance, for the Pench, Kuntum, and Wardah rivers, on special duty, but none of these have been carried out. I served in the Godavari district under Sir A. Cotton and had charge of the anicut works for some years, when I entirely revised the project with the cordial approval and thanks of the Government of India, of Sir A. Cotton, and of General F. H. Rundall, R.E., when Inspector General of Irrigation. I served also for several years in the Bellary district, which then included Anantapur and a part of the Kurnool district. Here I had to investigate Sir A. Cotton's project for the Tungabhadra river, and found the site for the reservoir he proposed to construct on it. In this district I investigated several other projects for irrigation and established the water-supply for the station. The details of these I can give, if required to do so.

I served for three years in the Madura district and reported on the Periyar project since carried out in this district. I believe a most useful reservoir can be constructed near Battagoonda on a stream, which is very abundantly supplied with water from the Palni hills, which would irrigate a good deal of land, and afford an excellent supply of water for the city of Madura, containing upwards of 100,000 people.

I have seen a good deal of the coast districts up to Ganjam, north of Madras, but very little of the southern districts, except Madura. I have no doubt many useful projects can be established in them. I have also had opportunities of seeing a good deal of the country about the Palmaner hills in the North Arcot district, and am quite satisfied that several good irrigation projects can be established on the Poiney, Gooriattam, Palar, and other rivers and some of this water would, in all probability, be available for the city of Madras, and keep that filthy sewer, the Cooum, clean.

In the Cuddapah district the tributaries of the Penner river offer several sites for large reservoirs; these waters would be of the greatest use also in the Nellore district.

The Penner river has a very steep bedfall, at the rate of 10 feet per mile in Bellary and 4 or 5 feet per mile even in Nellore; its floods therefore run off in a few days and require to be stored and better regulated by large reservoirs.

2. The average rainfall at Madras is about 48 inches. I regret I have not the means to supply further information in this point, but on this I will speak generally at the close of this paper.

3. (1) I should say certainly not from my own experience all over this Presidency.

(2) From the want of a good abundant water-supply conveniently situated, the villages all over Southern India suffer intolerable losses. The remedy for this can only be supplied by storing the rainfall in the best manner possible.

(3) When the cattle are so little cared for, the supply of manure must be very deficient and can only be remedied as above noted; for this is the only way to secure food and water for the cattle, and to preserve them in good working condition. A bullock in good condition is said to produce nearly a ton of manure per annum; yet no care whatever is taken of animals in India either by the people or the authorities.

(4) Almost all soils pay for irrigation purposes and "black-cotton soil" is more particularly irrigated in Madras; the best irrigation in Bellary is almost entirely "black-cotton soil," as also in the Madura district.

(5) The uncertainty of water-supply is the great drawback to irrigation all over Madras; I have always found that when I had secured a good water-supply for the rayat, "with facilities of access to markets for his produce," he was quite ready and willing to pay for the water if not interfered with by unlawful practices.

(6) Lack of capital always prevented me in doing all I could have done in all my service.

(7) I always endeavoured to come to some agreement with the people for a water-rate, and generally succeeded with them, but I fear after I left a district this was upset.

(8) I have no experience of this law, but of course if there is any uncertainty of tenure it will prohibit all agricultural improvements; this occurs all over the world.

(9) The great obstacles to the extension of irrigation are (*a*) uncertainty of the water-supply; by this all the labour and capital laid out in cultivation may be entirely lost, and then the rayat is hampered with arrears of land revenue; remissions are constantly being asked for; the cattle are left without proper food and water, and perish by thousands and generally are quite unfit for work. (*b*) No irrigation can by any means be successful "if facilities of access to markets are not provided at the cheapest rates possible." This is a rule to which there is no exception in all land improvements in every civilized country. (*c*) The waste of water must be prohibited by very stringent regulations; carefully attended to. I am convinced that more than half the water in our tanks is wasted by bad sluices, by a full supply being afforded to the lands day and night, for which there is no occasion, and generally by negligent management in such matters. As a general rule, I would never allow all the water stored in a reservoir to be run off in one season; at least 20 or 25 per cent. of it should be retained in it for the use of man and beast during the hot weather; also by this arrangement the bed is kept moist and all storm waters during the hot weather, which are now lost in the dry beds of tanks, would be conserved for use and the tank itself be better filled in any season when the rainfall was less than the average of the locality. (*d*) The cultivation of the babul tree round the wetted margin of all tanks should be encouraged. It affords good food for the cattle in the hot weather and the wood is useful for many agricultural implements.

4. I have no experience relating to this question having always acted for the Government interests; and these could have been much better attended to if more capital had been provided us for the extension of irrigation in all districts.

5. I have had no experience of the Land Improvement Act. I think loans of this kind are objectionable in many ways in India. The people are ignorant of all hydraulic engineering, and if money is offered them at the lowest rates of interest, they will accept it and go in for projects which cannot possibly pay. The result being debt and vexatious proceedings to recover money which has been hopelessly lost. I always ask the rayats to co-operate and execute the less laborious portions of a work, such as light earthwork, clearing out channels, removing trees, bushes, etc., from off the tank banks, whilst I did the more expensive masonry works, etc., out of Government funds, and found this course quite successful. I carried out this arrangement in Bellary in scores of instances, without any stamped agreements, and never had a single failure.

6. Certainly not. It must tend to improve the cultivation of all lands in the vicinity of good irrigated lands; all experience will confirm this in an agricultural country. I cannot understand why there should be any doubt about this; it has been a well-established rule since Adam Smith's time. In all my experience I have always found the people far more ready and willing to take the water for irrigation purposes than I had the means to give them the water. I have no hesitation whatever

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in saying I could have done ten times the work I did for the Government and the people if I had not been prevented by want of capital. I refrain now from mentioning some other most annoying and vexatious practices to which I was subjected, as it would answer no useful purpose ; but so far as the rayat of Southern India is concerned, he is always ready and willing to take the water and pay for it if it is only securely provided for him, and he is freed from demands which are only too often made on him in an unlawful manner, under pretence of making revenue for the Government, which should be most strictly prohibited, for it is most injurious to the name and character of the British Government in India and a mere copy of the old vicious Native Governments and still prevails where native rule has been established, the rayat not having any security that the demands on him will not be enhanced at every opportunity.

B.—Canals of Continuous Flow.

7. I generally estimate this approximately by considering that dry lands pay, on an average, an assessment of 8 annas per acre ; if water is securely supplied the people will readily pay an assessment of Rs. 5 per acre ; this is an increase of 900 per cent., and they would never agree to pay such an increase if they did not profit in a much greater degree themselves. This estimate of increase may be too high, but it gives a very fair idea of how much the land must be benefited by any good system of irrigation, which saves the rayat from all losses by the vicissitudes of the season's rainfall, etc.

(1) No canals in Southern India afford a certain supply of water for second crop or sugarcane cultivation. All are dependent on a season's rainfall, which is uncertain and can only be provided against by good reservoirs. The losses both to the Government and the people are enormous, and require to be prevented as much as possible by well designed reservoirs.

(2) If the people are so ready to pay for the water, it must be because they can substitute more valuable crops for cultivation.

(3) The yield must be far greater by irrigation, or the people would not take the water. The three points (*a*, *b*, *c*) I beg to deal with at the close of this paper.

8. On good canals it is estimated that a first crop yields a value of Rs. 20 per acre per annum, and a second crop may yield Rs. 10. It is quite impossible to get any satisfactory data on this subject ; for all practical purposes, the increase of assessment the people are willing to pay affords sufficient data to establish an irrigation project upon, "if there are good facilities of access to markets for the produce at all seasons."

9. The rate varies from about Rs. 2 to Rs. 5 per acre. So far as I know this rate is paid only on the area actually irrigated and to the Government.

10. I have no experience of this matter.

11. I have no experience of land being injured by irrigation. In the Godavari, I found Sir A. Cotton's instructions for draining the land had been entirety neglected ; and provided for this being done in my revised estimates, with very beneficial results, especially on the central delta. Drainage of such lands has not received proper attention in Southern India, and it should be strictly enforced. I have no experience of salt efflorescence and do not believe much in it.

C.—Canals of Intermittent Flow.

12 to 21. I regret to say I am unable to afford information on the subject, as we usually left the people alone to dispose of the water according to the arrangements they made with the Tahsildars, and approved of by the Collectors. I believe this practice was sanctioned by the Government.

22. I would afford every assistance for the extension of irrigation in Southern India, but think professional advice should be obtained as far as possible if the land belongs to Government ; but as regards private persons constructing canals on Government lands, they might be encouraged by remitting the water-rate for some years. This is a question which involves so many interests. I do not think it can be solved very easily where land is public property, of which the Government are the guardians ; in the interests of the community they cannot part with the benefits of irrigation for all time. So far as I am able to judge, I would much prefer to carry out all improvements by capital borrowed by the Government, and create a sinking fund, if possible, from the profits to pay off the debt, say, in one generation, and keep all such works under good Government management and supervision and so do away with many vexed questions about repairs, maintenance, etc. So far as my experience extends, these small works have not come under my care. I have always considered that many of them might be done away with, and all such streams, rivers, etc., examined to see if reservoirs cannot be constructed on them, and secure good means of irrigation, and to provide food and water-supply for the people and their cattle, when the revenue from them would be far more secure. So far as I know, the revenue from such temporary works is very small, and liable to be lost by many accidents, as sudden flood sweeping them away, when all labour, etc., in cost of construction is also lost, and the outlay must be all incurred over and over again. I cannot conceive how they can be remunerative to any one, and are only resorted to as a last desperate means, to secure a livelihood for man and beast. We have an instance in the Nagpur water-works of how much water can be stored in India from a very limited drainage area, having an average rainfall of about 40 inches in the year, and on these lines and data I would advocate the constructions of reservoirs on all such streams as are referred to in these questions, and consider they would pay directly and indirectly.

D.—Tanks.

23. (1) In the districts I have served, the tanks are generally supplied with water from the rainfall in their several catchment areas. In some instances, notably in Madura, the tanks are also fed by channels from rivers such as the Vaigay.

(2) The water is supplied to the land from sluices in the tank banks, and led to the land by ordinary channels.

(3) This is entirely dependent on the season rainfall and cannot be specifically replied to. The tanks require to be remodelled to secure a good water-supply for at least two years' supply.

(4) The areas vary from 3 acres to 10,000 in some cases ; all dependent on a season's rainfall. Of this, sufficient advantage has never yet been taken.

24. (1) If the tanks were made of sufficient capacity, they could irrigate for two crops, on limited areas, to be carefully marked out.

(2) If water is properly supplied in Southern India, more valuable crops are always cultivated.

(3) The yield depends entirely on the season's rainfall, and requires to be more carefully stored in large reservoirs and far more carefully distributed.

25. If the irrigation is at all uncertain, everything is dead loss almost ; hence the accumulation of capital by the rayat is impossible, and accounts for a great deal of his general poverty.

26. It may be in some instances ; but wells are usually so uncertainly supplied with water in Southern India, they cannot be relied on to afford a good water-supply for irrigation purposes.

27. The total annual value of the produce per acre depends so entirely on the season's rainfall, and the manner in which this is stored and properly distributed ; it is very difficult to estimate it even approximately. I have always found the rayat so ready to pay for the water when securely provided for him, that the benefits he derives from it must be incalculable.

28. This varies from 2 to 7 rupees per acre, I believe ; and is paid, so far as I know, by the cultivator to the Government. I have had no experience about it with private owners. Having always dealt with Government rayats, I have always calculated on obtaining a rate on the area actually irrigated. Remissions, etc., are made by the Revenue Department as represented to the Collectors. Engineers are not permitted to interfere at all in such matters.

29. I am not aware that this practice prevails at all in Southern India.

30. This is usually executed out of the repair funds allotted by the Government and much money has been, and is still being, wasted on this account. In Bellary I reduced the cost of maintenance by 50 per cent. by thoroughly repairing the tanks, etc. It is impossible to state the cost per acre per annum under the existing system, which I believe cannot possibly work well. I do not think legislature would be of any use ; it can be far better remedied by constant and careful professional supervision by the Public Works Department.

31-32. I do not think it is at all advisable to allow private persons to construct tanks in Southern India. So far as I can judge it would only lead to endless litigation. There is absolutely no difficulty whatever for the Government to carry out all irrigation projects, secure the public interests, as well as those of the people by tolerable management if funds are provided for these purposes.

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33. Some tanks are considerably silted, but the rate of silting has never been recorded. I think dredging could be usefully applied in large tanks and reservoirs. The best remedy for preventing the silting up of tanks is to encourage the rayats to dig this out and use it as manure, free of all charges under pretence of making revenue for the Government; this way of dealing with the people prevents all improvement in India, as no one knows how much may be demanded of him, by even a peon with a belt for the Government. In famine times when the tanks are quite dry, the people can be well employed in removing the silt out of their tanks and casting it away by hand-carts to their fields, in every village to so carry out the system of relief in their own villages.

E.—Wells.

So far as my experience goes I do not think that wells can possibly be relied on for any water-supply for irrigation purposes in Southern India. The primary rock formation prevails so largely here, and all our experience hitherto has shown that these rocks have been subjected to such convulsions and are so full of faults and fissures, it is impossible to trace the under-ground drainage amongst them, and the attempt to do so has so often failed, it is recommended now that the practice should be given up. We have the experience of the Kolar Gold-fields to show that little water can be obtained in the primary rocks. They have sunk shafts, 2,000 feet in depth, and run out galleries in all directions for many miles without being incommoded by the water; in fact, they are considering a project for constructing a large reservoir to supply these gold-fields with water in an adjacent river. In general, the Public Works Department has not charge of wells for irrigation purposes. I have found water for supplying the troops in a station, for drinking purposes, successfully in Bellary by boring and well-sinking; but I could hardly recommend this operation for a permanent supply for irrigation purposes. The water I found was very good and clear, notably between the hills, for the supply of the European barracks at Bellary. This well has been in use for more than 40 years, but the quantity is very limited, and though of excellent quality, it was considered inadvisable to attempt to deepen the bore-hole for fear of touching the rock, when the whole supply would most probably be lost. I know of only one other place, near Ramnad in the Madura district, where artesian wells might be sunk with success, as the local formation appears to be favourable, and I understand the Railway Engineers now contemplate making the attempt. Round the margin of large reservoirs, temporary wells, Norton's tubes, etc., might be used for irrigating pasture lands, but on no account should any ploughing or digging be permitted, as this would certainly allow of silt being carried down into the reservoirs. By some such arrangement, a good supply of food and water could be afforded to many villages in the vicinity of all large reservoirs; and the larger these are made, the more useful would they be in all districts of Southern India.

In conclusion, I beg to add I have no sufficient records or data on hand to give information on the points noted, as supplies of water or cultivation in years of ample rainfall, scanty rainfall or in seasons of drought. I believe we have no such records in this Presidency and a great deal requires to be done on this matter. But I beg to refer the Commission to the paper read before the Civil Engineers' Institution, London, in 1874 by the present Sir Alexander Binnies, C.E., on the Nagpur water-works which he carried out and the success of this project confirms the data he had worked upon. The general results can be briefly summarised. Sir Alexander selected the Ambagiri tank for his purposes. This reservoir has a catchment area of 6·6 square miles, and held only 80,000,000 cubic feet of water. He enlarged it so as to contain a gross quantity of 257,500,000 cubic feet and the conclusion he arrived at after more experience was that it might have been enlarged to contain 70,000,000 cubic feet more, on an average; that is to say, from a catchment area so small as 6·6 square miles having an average monsoon rainfall of 37·0 inches he calculated he could store 327,500,000 cubic feet of water. This gives a yield of about 1,800,000 cubic yards per square mile of drainage area; and if we estimate that an acre of land requires 10,000 cubic yards for one crop of rice cultivation, his data show that from every square mile of drainage area we can on an average cultivate 180 acres for one crop by storing the water in a basin when the rainfall is by no means heavy for the tropics. The average annual rainfall at Nagpur from 19 years' observations is 40·73 inches. Of this amount 37·5 inches fell during the monsoon months from June to the early part of October; the balance 3·21 inches fell in showers during the rest of the year. When it was proposed to increase the store of water in this reservoir in 1889-90 by 15,000,000 cubic feet, it was recorded that Sir A. Binnies' work had been a complete success. The information he gave in his paper regarding the rainfall, the run-off, the losses by evaporation and percolation, etc., is by far the best I have ever met with; and with modifications to suit other localities can be readily used for all parts of India. His remarks on the fluctuations of the rainfall in the tropics are of the greatest importance, as they show how necessary it is to make all reservoirs in India of the largest capacity possible so as to store and modify these enormous fluctuations. How great these are, he instances in two well known cases: in Madras 23½ inches of rain has fallen in 24 hours, when the average is about 48 inches in the year; and in Bombay 14 inches was gauged in 24 hours, when the average fall is about 70 inches in the year; that is to say, 50 per cent. of the average rainfall fell in a day at the former place and fully 20 per cent. in the latter. In all such instances it is a well-known fact the floods in all the rivers of India discharge immense volumes of water with great rapidity as their beds have very steep inclines, and in a few days or even hours, immense volumes of water run off uselessly into the sea, which Sir Alexander pointed out 30 years ago should be modified by good storage reservoirs; and there is no difficulty in finding good sites for such works on the rivers and their tributaries in Southern India; and during my service I have noted many places where very valuable reservoirs might be constructed, but never had the means to work these out, except for one of the Godavari district, which was calculated to irrigate 45,000 acres of land and to moderate the floods of a large jungle stream which does much injury to the western delta. But the estimate has never been sanctioned, though it was all prepared and ready in 1872. In Mysore, where the average rainfall is 36 inches in the year, falls of 6 and 9 inches *in one night* have been recorded. As the general incline of the Mysore plateau towards the east coast is about 15 feet per mile, the waters of such rainfalls run off most rapidly, and are all lost for want of good storage reservoirs in the basins of its rivers such as the Cauvery, its tributaries, and minor catchment areas.

I can only give a general idea about such works. Every project must be well looked into by itself. For instance, the reservoir on the Tungabbadra river would be full all through the monsoon season without a doubt; so the question of its water-supply is very simple, but the distribution of this in the hot weather must be carefully regulated so as to make it last as long as possible. This river receives at times large quantities of water by heavy storms in the hills during the hot season; but these cannot, of course, be depended upon. In a river like the Penner, which only receives a moderate supply of water from the south-west monsoon, and all its heavy flood waters from the north-east monsoon, which last only for short periods, and rush off with great velocity, it will be necessary to have several reservoirs if its waters are to be fully utilized in the Cuddapah and Nellore districts.

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1. *Q.* (*The President.*)—We are much obliged to you, General Fischer, for the memorandum you have sent to the Commission. I think you are the senior Irrigation Officer now in India?—Yes, Sir.

2. *Q.* You say in your memorandum that "in the Cuddapah district the tributaries of the Penner river offer several sites for large reservoirs." Do you know if the district was ever surveyed?—No, I believe not.

3. *Q.* As a matter of fact, no water is stored?—As far as I know nothing is done to store up water. We have had plenty of tanks, large tanks; some old native tanks, but excepting the Penner project no other project was carried out; nothing in the way of storing water is done in any part of this country or in the Central Provinces. We have had a number of projects in addition to the Tungabhadra; another project was the Tungabhadra river project in the Bellary district; there was also a project for the Chinna Huggri river; they have not been carried out; nothing has been carried out except the Kistna and the Godavari works on any proper scale for the storage of the ordinary rainfall in Southern India or for its proper distribution in any economical manner.

4. *Q.* I think one of the greatest difficulties that we have evidence of before the Commission is the presence of black-cotton soil in most places?—I don't understand why; in most parts of the Bellary district black-cotton soils are very largely irrigated. On the Tungabhadra channel it is entirely a black-cotton soil.

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5. *Q.* We had only this morning evidence to the effect that rayats are greatly reluctant to irrigate in black-cotton soil. We have evidence that in Kurnool and Kuddapah it is very difficult to get rayats to take up irrigation under the Kurnool Canal?—The question is whether they could get sufficient water in the proper season. I don't think the Kurnool Canal was carried out in a proper way; the original project was to carry the canal on a contour on either side of the valley of the Kunderu, the water being distributed on both sides of the valley; it was to be joined to the Buckingham Canal (discussion on the map followed).

6. *Q.* Was not this line approved by Sir Arthur Cotton?—No. The Company carried out the work in their own way.

7. *Q.* It was Sir Arthur Cotton's brother who selected the line?—He was not very long here; he was too old at that time. Colonel Hugh Cotton had been twenty years in service; I don't think he was very long here. I never knew anything of this project until Lord Wenlock laid the whole papers before me. I then said it was a great mistake. It should have been carried on a higher level (refers to the map). You must get an outlet; navigation ends in a desert.

8. *Q.* We have got railways in most places now?—Railways don't suit; they have done nothing for the land in England.

9. *Q.* Railways have driven navigation out of Egypt?—Because they have no proper navigable canal. I could only tell you what has occurred to us in the Godavari district; you must remember that railway freights are heavy freights.

10. *Q.* The question of irrigating Bellary seems to be a difficult one?—I believe the Tungabhadra project is perfectly feasible, but the whole thing must be changed. It will never do to carry it out on the lines they have surveyed; they must be entirely changed; they have gone on avoiding all rock cuttings.

11. *Q.* You say there were levels taken?—Those were my own levels.

12. *Q.* Are those records in Madras?—Every paper of mine has been lost; every single paper.

13. *Q.* It is a great misfortune; I understand you proposed a reservoir near Hospet?—Yes.

14 *Q.* You say, General, in reply to question 3—"I always endeavoured to come to some agreement with the people for a water-rate, and generally succeeded with them, but I fear after I left a district this was upset"?—Yes; we made arrangements with the revenue officers and prepared proper estimates; these estimates were signed by the rayats and sent on to the Collectors who countersigned them. I had no difficulty about it, for the rayats were very willing to do the work themselves. During the mutiny it was very difficult to get money.

15. *Q.* This was before the days of the Public Works Department?—This was in 1855. 1857-58 were mutiny years, and the Public Works Department was cut down very much. We were able to do nothing except ordinary repairs and military works.

16 *Q.* You say—"as a general rule, I would never allow all the water stored in a reservoir to be run off in one season; at least 20 or 25 per cent. of it should be retained in it for the use of man and beast during the hot weather"?—I would not. The great object of one of these reservoirs is to keep a supply of water for the surrounding villages. Supposing you had a thousand millions cubic feet of water stored in the tank, I would keep 250 or 300 million cubic feet left in the tank.

17. *Q.* Merely to soak into the ground?—It does not soak into the ground; if land is once saturated, it does not absorb much.

18. *Q.* This tank would be replenished from year to year?—If it is, so much the better; in the year of very short rainfall or a great deal of distress, stored water in a big reservoir would be of great assistance to many of the surrounding villages in supplying drinking water and keeping their cattle supplied with fodder and water.

19. *Q.* You must have had experience of the silting up of tanks. Have you known cases where silting up was rapid enough to be measured?—In the black-cotton soil tanks silt up a great deal. These tanks in Bellary are very old and for many years they don't seem to have silted up. I saw in some papers a report of the *Daroji* cultivation; but there is one thing it receives its water from the Sandur valley; the zaminder cut away all the jungle and as a result the rainfall has diminished from 45 inches a year to 22 inches. The Superintendent of Forests under the Government of India noticed this in his report; this is a very serious question. It would be better to have a reservoir down here (refers to the map).

20. *Q.* It has not been surveyed?—They tried; it is all sand; they could not make a reservoir. There is no reason why you should not make a reservoir, because it is sand; sand is the best thing for foundation you can possibly have if it is well managed.

21. *Q.* You have no experience of the mischief done by *reh*?—I have never seen anything of it in Southern India.

22. *Q.* We have been told that there is a good deal of it in Kurnool. Have you seen it?—A small area near the canal is affected.

23. *Q.* We hear that some places have become quite unfit for irrigation?—I have not seen them; you can always get rid of salt very easily with fresh water. A good deal of land was water-logged on the Godavari, because they had not got drainage; in 1869 drainage was carried out and an immense quantity of land was recovered.

24. *Q.* (*Mr. Higham.*)—I understand you to say, General Fischer, that the failure of the Kurnool rayats to take the canal water was due to the Kurnool Canal having been taken on a wrong line?—Yes; it was taken down the valley of Kunder instead of on a higher level. You cannot irrigate up-hill.

25 *Q.* Which side of the valley would you have taken the canal?—Both sides.

26. *Q.* You don't know why they took that alignment?—I don't know; I had nothing to do with it.

27. *Q.* Your line of canal was originally alongside the valley?—They took the project out of my hands; I never saw it for years afterwards.

28. *Q.* Still why won't people take water for the land which is commanded?—Because they have got no market for their produce; they have got no means of communication to get their produce away.

29. *Q.* How do they get their dry crops away?—They are sold locally a good deal.

30. *Q.* According to the information we have, the produce from dry crops in a good year is extremely heavy?—Yes; there are many good years compared with bad years, but the rayats are perfectly ready to take water if you give them proper means of carrying the produce away.

31. *Q.* Don't you think a rayat would make more from dry crops than irrigated crops?—On an average you get about 8 annas an acre assessment on dry crop. The rayat would never pay wet assessment if he is not benefited; the profit he gets is about Rs. 2-8-0 per acre on dry land compared with Rs. 20 per acre on wet land on an average. The rayat would never take water unless he was confident of getting full supply.

32. *Q.* He would have to devote more labour and time to wet cultivation than to dry?—Certainly; but he is more certain of his profit on wet crops than on dry crops. Dry crops in India are a very precarious cultivation.

33. *Q.* If the Kurnool Canal were made navigable and connected with the Buckingham Canal, would people take water for converting their lands into wet?—I think they would, as soon as they see their way to it; they are very chary about taking water until they see water available.

34. *Q.* They have had an opportunity of seeing it for twenty years?—Yet they hold on, because they have no outlets to markets by cheap water-ways.

35. *Q.* We are told that Nellore is a suitable district for irrigation?—I think it is; you have got a sufficient supply of water and you could make a reservoir on the Penner river.

36. *Q.* What do you suppose would be the irrigation in that district supposing you get sufficient water?—Certainly, one or two millions of acres of land.

37. *Q.* You say you cannot get storage in Nellore district itself?—On the Penner you cannot get a very large quantity of water; you will have to depend on the Tungabhadra; you will have to make a very large reservoir; the rainfall, as you know, is precarious.

38. *Q.* You require water from other basins to supplement the supply of the Penner?—Yes; the Tungabhadra and the Kistna get their entire supply from the Western Ghats, and they never fail. I don't think you could entirely depend on the Penner.

39. *Q.* (*The President.*)—You say that water should be stored in a reservoir on the Tungabhadra for use in Nellore?—Yes.

40. *Q.* It would be taken down below Kurnool?—Yes and join the Buckingham Canal (refers to the map).

41. *Q.* (*Mr. Higham.*)—What area could be protected in the lower districts from the Tungabhadra project?—About 3 million acres.

42. *Q.* That is the whole cultivable area of the district?—Oh, no; the area of Nellore is 9,000 square miles.

43. *Q.* Do you think you could bring down enough water for that?—If you get a good supply of water you might have 3 millions. I should be quite satisfied if I got one million.

44. *Q.* Do you think you can bring water by means of the present Kurnool Canal?—No; by taking another canal through the Kunder valley you get a much larger quantity of water.

45. *Q.* You would have to reconstruct the Kurnool Canal altogether?—Yes.

46. *Q.* I understand you to say that Sir Arthur Cotton wanted to bring water from the Tungabhadra through the Bellary district into Nellore?—Yes.

47. *Q.* You think it is quite impracticable?—Yes; the levels will not permit it.

48. *Q.* I suppose you have seen Mr. Gordon's alignment?—Yes.

49. *Q.* As far as your investigation went, it was not possible to take the supply through the Bellary district?—No; not without making about 300 or 350 miles of canal.

50. *Q.* (*Mr. Nicholson.*)—Did you find it possible to work the *kudi-maramat* system in your time?—No.

51. *Q.* The rayat executed minor repairs to the tanks?—Yes, I always tried to repair the tank as much as possible under professional supervision. I don't think it ought to be left in the hands of uninstructed native people.

52. *Q.* Did you find that the long standing custom of making all classes of petty repairs by the people at their own cost was practised and practicable in your days?—It was practised; but it is not a very good system; it is far better for professional men to see the tank, to put it into working order, and to make the rayat do the lighter part of the work.

53. *Q.* Originally was it not the custom that all classes of repairs should be undertaken by the rayats?—It was.

54. *Q.* In the early part of the century?—Yes.

55. *Q.* Gradually all that fell into desuetude?—Yes; and I believe an enormous quantity of water is wasted.

56. *Q.* Regarding some of those old projects do you remember whether one of them was that the water-supply of the Palar basin should be augmented by waters of the Tungabhadra? Do you remember any such projects as a part of Sir Arthur Cotton's scheme?—I think there was some project for the Palar river.

57. *Q.* There was some project for carrying water to the Palar valley from out side?—I don't remember; I think you would have to go through the Mysore country to join the Palar valley.

58. *Q.* (*Mr. Rajaratna Mudaliar.*)—Do you also remember Sir Arthur Cotton speaking of high level reservoirs on the Nilgiris?—Yes.

59. *Q.* There was an attempt to carry out a high level reservoir?—Yes. By the silting process.

60. *Q.* Do you remember of his speaking of a survey being made on the Nilgiris with reference to a reservoir so far back as 1828?—No.

General J. F. Fischer.

61. *Q.* The idea of the reservoir was a proper one?—Yes, it would be of lasting benefit to the country. The silting process failed so entirely it discouraged people and, in consequence, the storing of water in Southern India, on any proper scale, has been neglected altogether.

The above questions and answers give so imperfect an idea of what I stated before the Commission, I request the following explanations may be added:—

I urged before the Commission the absolute necessity of providing facilities of access to port or market to make irrigation successful, as this is one of the most fundamental points connected with all improvements in relation to land cultivation; and I illustrated this by the road I had made for the Singanamulla tank in the Bellary district—by making the Uttuli Canal navigable in the Godavari district; as also by the falling off in the trade of the port of Cocanada, by the stoppage of through navigation for four months only, by the failure of the head lock in the eastern delta.

2. I described to the President and Mr. Higham, on the map, how I had fixed the site for the reservoir on the Tungabhadra river, and pointed out the manner in which the canal should be taken through the hills to above the Darojee tank; and, round this, on to the south of Bellary, and discharged thence into the Huggri river; whence, by an anicut, the water can be very easily distributed over the Adoni and Pattikonda taluks, and a connection established with the Kurnool works; and thence the canal requires to be carried into the Nellore district, so as to connect with the Buckingham Canal; by these means the navigable canal, proposed by Sir Arthur Cotton, from the Bellary district to the coast, can be very easily established. From the south of Bellary I showed them a contour can be run up the Huggri valley, and across that river to discharge water into the Penner basin.

3. I believe nearly one million acres of land can be irrigated in the Bellary district as above sketched out by me. I should say half a million of acres can be irrigated in the Cuddapah district; and, in the Nellore district, fully a million and-a-half of acres can be irrigated from the Penner river by suitable works; and the deficient supplies of water in this basin are increased from the Tungabhadra and the Kistna rivers, which always have a superabundance of water in them, during *every* monsoon season.

4. Many sites exist in the Penner basin for large storage reservoirs; but this river is very slightly affected by the south-west monsoon, as it rises in the middle of Mysore, and not near the Western Ghats. If the north-east monsoon is heavy, the Penner receives an abundant supply of rainfall, which now runs off very rapidly to waste into the sea. It is, therefore, advisable to secure as much of this as possible in large storage reservoirs; but to afford the full benefits of irrigation to the Nellore district, and to secure through navigation from Bellary to the coast, the only rivers which can be relied on, in this part of India, are the Tungabhadra and the Kistna.

Mr. M. R. Kharegat, Assistant Chief Engineer for Irrigation, Tank Restoration Scheme.

(*Madras, 11th February 1902*)

(Answers to Questions for Public Works Officers.)

Mr. M. R. Kharegat.

Question 5. Statements showing the number and irriating capacity of the minor works in each district are iven in the Special Superintending Engineer's report.

The works may be divided into three groups:—

(1) Works wholly belonging to Government.

(2) Works belonging partly to Government and partly o private owners, inamdars, and zamindars, etc.

(3) Works wholly belonging to private owners affectng lines of railway or systems of irrigation works.

Groups (1) and (2) may again be sub-divided into "Imerial" and "Minor" or, as they are now termed, "Class V (*a*)" and "Class IV (*b*)" works in charge of the Public Vorks and Revenue Departments, respectively, the broad ne of demarcation being a capability of irrigating more or ss than 200 acres (*vide* paragraph 3 of note on the Tank Restoration Scheme in report of the Special Superintending Engineer).

In group (1) Government enjoys the whole revenue derived from the lands irrigated and undertakes the maintenance of *all* works. The Tank Restoration Scheme deals only with works irrigating *more than 10 acres*.

In group (2) Government enjoys the revenue on the rayatwari lands irrigated and generally the quit-rent on the remainder. Government undertakes, as a rule, the maintenance of such works, a contribution from the private owners being levied in proportion to the extent of their interest in the work, which is determined from a consideration of the extent of lands irrigated by each party.

In group (3) the works are repaired and the revenue derived from them is enjoyed by the owner. Government, however, steps in in the case of tanks threatening danger to

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a line of railway, a Government work or system of works, to see that the works are kept at a safe standard (Railway Protection Act IV of 1886).

During the progress of Tank Restoration Scheme operations, estimates for repairs of all the works mentioned above are prepared, estimates for groups (1) and (2) being sent to the Superintending Engineers for execution, while those for works under group (3) are sent to Collectors to have them carried out by the parties concerned.

For class IV (*b*) works not taken up for investigation, or for those already repaired under the Tank Restoration Scheme, estimates for repairs are prepared by Collectors and sanctioned up to Rs. 500. Estimates exceeding this amount have been sent to the Board of Revenue through the Tank Restoration Scheme office where they have been scrutinized. Under recent orders estimates exceeding Rs. 500 and within the powers of sanction of Superintending Engineers will be sent to these officers for sanction (G. O. No. 2631-W., dated 3rd October 1901).

The rayats interested in works of groups (1) and (2) are expected to carry out "petty repairs" under *kudi-maramat*, such as clearance of silt in channels and removal of prickly-pear on *bunds* of tanks, etc.; but it is believed that in many districts very little is now done by them.

The accounts regarding expenditure, etc., on these works are being prepared in the Irrigation office.

The object of the Tank Restoration Scheme is to systematically investigate the position and requirements of each irrigation work with reference to the irrigation works above and below it, lay down a standard of efficiency for each work, collect financial and hydraulic details of the same, bring each work to the standard of efficiency and to record the information collected for the future guidance of the officers of the Revenue and Public Works Departments.

The number of works investigated and the average area and revenue dependent on them are shown in columns 3, 4, and 5 of statement A.

The number of works on which improvements have been carried out and the cost of improvements are given in columns 6 and 7, respectively, of statement A.

The average area irrigated and revenue derived before the improvements are given in columns 4 and 5 of statement A.

"The average area irrigated and the revenue derived after the improvements" are difficult figures to arrive at owing to the fact that the "execution" of works is spread over a vast number of years; and to prepare such statements the exact date on which each work was completed must be known, and this information is not fully available. The tabulation of the figures is one that can only be done in the Revenue Department.

The figures shown in columns 8 and 9 of statement A are approximate, but must be considerably in excess of actuals as explained in the "Remarks" column of the statement.

"The number of works investigated more than three years ago, but not taken up for repairs for want of funds." The above particulars are given in statement B.

The correct number of works pending execution on 31st March 1901 cannot be given owing to the number of partially completed works entering into the calculation. For practical purposes, however, the expenditure and not the number of works will suffice.

Owing to the aggregate grants for the three years, 1898-99 to 1900-01, being generally in excess of the balance of estimates in hand on 31st March 1898, there are only two districts—Chingleput and Madura—in which estimates may be said not to have been taken up for three years for want of funds. It must not be forgotten, however, that in some districts, such as Tinnevelly, Chingleput, and Anantapur, the investigation work has been stopped on account of the large balance of estimates in hand.

"Work done and remaining to be done" in the Presidency under the Tank Resolution Scheme—

	Sq. miles.	
Total area to be investigated . . .	116,855	(approximately).
Area investigated to 31st March 1901 . .	45,459	(„)
Area still to be investigated	71,396	(„)

or about 61 per cent. of the work to be done.

Another method of calculation is this—

	Acres.
Average area affected by all works to be investigated . .	2,234,288
Average area investigated to 31st March 1901 . . .	750,255
Average area still to be investigated	1,484,033

or about 66 per cent. of the work to be done.

(i) Expenditure incurred on the work of survey or investigation is Rs. 15,98,704 approximately (*vide* statement C).

(ii) and (iii). No distinction is now made between improvements and repairs, so that the expenditure incurred under each head cannot be separated.

The estimated cost of repairing works up to 31st March 1901 is Rs. 65,30,312, or Rs. 65,61,973, including the charges for tools and plant (*vide* statement C).

No doubt there has been some improvement in the protection afforded by works which had been repaired under the Tank Restoration Scheme, both in extent and certainty; but sufficient data are not available to point to marked improvement which may be attributed to this expenditure; such data should also take into account the cause and nature of remissions, character of the seasons, etc., before and after the execution of the repairs. It may certainly be affirmed that the expenditure has prevented retrogression for some years after the execution of repairs; but unless some satisfactory means are devised of maintaining the works, the *bunds* will again deteriorate. The expenditure incurred, however, on sluices and escapes is in most cases of permanent benefit.

Under the Tank Restoration Scheme it is intended to deal with all the works in the presidency, excluding the West Coast, the Nilgiris, private territories, and the large systems of irrigation works in charge of the regular Public Works Department officers, so that the total number of the works cannot be increased, though the number dealt with in a given time could be greatly increased by the assignment of more funds.

The efficiency of the works could be improved if more funds were made available; but it is rather the aim of the Tank Restoration Scheme to bring works to their normal standard of efficiency or to the standard of efficiency to which they were originally designed as nearly as can be, allowing the ordinary divisions to deal with the increase of efficiency.

The distribution of the funds now available is determined in the Irrigation office with reference to the applications made by the Superintending Engineers and the number of estimates likely to be sanctioned for each division having due regard also to the limited funds available (*vide* statement D).

No alteration in the existing system in this respect seems called for.

A.—Statement showing the number of works [Class IV (a) and (b)] investigated under the Tank Restoration Scheme from the commencement of operations up to 31st March 1901 and the revenue dependent on them, etc.

No.	Districts.	Number of works investigated by Tank Restoration Scheme.	Average area cultivated under works in column 3 before investigation.	Average collection of revenue before investigation.	Number of works on which improvements have been carried out.	Actual cost of improvements on works shown in column 6.	Proposed *ayakat* after improvements (approximately).	Expected revenue after improvements (approximately).
1	2	3	4	5	6	7	8	9
			Acres.	Rs.		Rs.	Acres.	Rs.
1	Ganjam . . .		Not entered upon by the Tank Restoration Scheme.					
2	Vizagapatam . .	142	20,421	55,337	137	1,31,676	22,565	90,657
3	Godavari . . .	176	13,081	27,478	174	1,01,058	15,911	39,952
4	Kistna . . .	204	12,681	56,958	200	1,53,395	14,124	73,567
5	Nellore . . .	282	71,866	3,16,658	18	1,02,558	88,835	3,93,898
6	Cuddapah . . .	111	7,183	36,872	64	32,639	7,995	39,560
7	Kurnool . . .	224.	22,185	95,822	220	2,09,045	30,346	1,41,322
8	Anantapur . .	123	27,364	95,065	72	65,756	25,335	1,00,046
9	Bellary . . .	23	1,437	6,994	21		1,920	9,614
10	Salem . . .	847	48,078	2,18,430	546	3,13,049	53,330	2,47,969
11	Coimbatore . .	147	85,382	2,04,623	147	2,82,080	41,041	2,20,166
12	North Arcot . .	856	84,545	4,10,311	704	6,55,691	88,267	4,35,929
13	Chingleput . .	1,052	186,666	6,30,663	911	11,11,387	189,108	6,52,634
14	South Arcot . .	128	23,598	1,21,626	99	2,71,536	27,292	1,47,500
15	Tanjore . . .	241	30,646	81,674	221	2,66,845	32,355	88,671
16	Trichinopoly . .		Not entered upon by the Tank Restoration Scheme.					
17	Madura . . .	1,148	101,810	3,89,373	1,096	11,22,552	111,236	4,51,313
18	Tinnevelly. . .	593	60,312	2,83,619	863	4,90,609	61,670	3,48,597
	Total .	6,297	750,255	30,31,503	4,993	53,09,876	811,330	34,81,295

Note.—The figures in columns 8 and 9 are based on returns approved by Collectors, and they are generally framed on the supposition that the full *ayakat* would be cultivated after improvements have been carried out; but in many instances this can never be the case owing to insufficient supply, general deterioration of works, etc.

B.—Statement showing the amount of Tank Restoration Scheme estimates sanctioned prior to 31st March 1898, but not taken up for repairs up to the end of 31st March 1901.

No.	Districts.	On the 31st March 1898.		1898-99 to 1900-01.		On the 31st March 1901.		During the three years 1898-99 to 1900-01.		Balance at the end of March 1901.
		Balance of estimates in hand.	Balance of amount of estimates in hand.	Number of estimates taken up during three subsequent years.	Amount of estimates worked out during the three subsequent years.	Number of estimates remaining unexecuted.	Amount of estimates remaining unexecuted.	Number of estimates sanctioned during the three years.	Amount of estimates sanctioned during the three years.	Amount of estimates.
1	2	3	4	5	6	7	8	9	10	11
		Rs.	Rs.		Rs.		Rs.		Rs.	Rs.
1	Ganjam .	...	...	...	...	...	...	...	...	...
2	Vizagapatam	...	...	...	...	...	...	...	...	...
3	Godavari .	19+1	11,386	19	14,925	1	— 3,539	1	6,420	2.881
4	Kistna .	23+8	6,473	37+5	13,715	— 14+ 3	— 7,242	10	9,122	1,880
5	Nellore .	16+54	39,975	16+168	97.050	0+ — 114	— 57.075	210	2,54,999	1,97,924
6	Cuddapah .	...	...	...	...	...	...	...	...	...
7	Kurnool .	...	...	...	...	...	..	...	...	...
8	Bnantapur .	...	...	...	...	...	...	...	...	...
9	Aellary .	...	...	...	...	...	...	...	...	...
10	Salem .	233+56	37,557	120+287	1,03,419	113+ — 231	— 65,862	132	1,04,959	39,097
11	Coimbatore.	...	..	...	...	...	...	...	...	...
12	North Arcot	141	50,624	220+147	2,12,982	— 79+ — 147	—1,62,358	231	2,81,270	68,912
13	Chingleput	116+109	1,70,218	138+128	1,12,653	— 22+ — 19	57,565	53	71,934	1,29.499
14	South Arcot	58	25,831	55+29	52,762	3+ — 29	— 6,931	26	64,314	57,383
15	Tanjore .	110	22,324	92+37	22,685	18+ — 37*	— 343	2	8,389	8,046
16	Trichinopoly	...	...	...	...	...	...	...	...	...
17	Madura .	104+30	1,45,795	88+53	97,999	16+ — 23	47,796	6	25,888	73,684
18	Tinneveliy .	59+69	97,349	149+214	1,71,114	— 90+ — 145	— 73,765	251	2,58,432	1,84,667
	Total .	...	6,07,550	...	8,79,304	...	—2,71,754	...	10,35,727	7,63,973

This figure is doubtful.

NOTE 1.—It is assumed that estimates partially worked out at the end of one year will be completed in the subsequent year.

NOTE 2.—(*a*) The first number in column 3 denotes partially completed works and the second number represents works not taken up for execution.

(*b*) The first number in column 5 denotes fully completed works. The second number represents works partially completed.

(*c*) The figures in column 7 are the algebraic differences between those in columns 3 and 5 respectively.

(*d*) The minus figures in columns 7 and 8 indicate that new estimates sanctioned during the three years, 1898-99 to 1900-01, have been taken up.

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C.—Statement showing the amount of estimates sanctioned by the Tank Restoration Scheme, cost of investigation, and the cost of execution, including tools and plant charges up to 31st March 1901.

Years.	Estimates sanctioned for Government works.	Cost of investigation.	Cost of execution (including establishment and tools and plant).
	Rs.	Rs.	Rs.
1883-84	8,19,871	52,056	1,425
1884-85		1,23,352	63,717
1885-86		1,73,664	1,61,311
1886-87		2,17,507	2,49,379
1887-88	2,04,525	86,388	2,71,667
1888-89	4,94,309	1,31,807	4,37,107
1889-90	6,07,407	1,03,541	5,03,724
1890-91	7,23,517	82,502	5,87,335
1891-92	5,53,572	68,857	6,05,019
1892-93	3,51,930	66,068	3,88,345
1893-94	4,04,025	62,647	3,78,443
1894-95	4,07,047	56,136	4,48,774
1895-96	2,77,861	54,038	5,33,615
1896-97	1,82,437	63,229	5,49,777
1897-98	2,23,712	54,157	3,06,276
1898-99	3,78,730	75,074	3,30,534
1899-1900	4,30,147	69,306	3,66,676
1900-01	4,71,252	59,049	3,77,814
Total	65,30,342*	15,99,378	65,60,938 or 53,03,295, excluding establishment and tools and plant.

* For works only.

D.—Statement showing the grants allotted to the Superintending Engineers on account of Tank Restoration Scheme works in the several districts.

Districts.	Grant for 1898-99.	Grant for 1899-1900.	Grant for 1900-01.	Total.
	Rs.	Rs.	Rs.	Rs.
Ganjam	...	...	...	...
Vizagapatam	...	...	2,500	2,500
Godavari	4,000	1,000	2,000	7,000
Kistna	10,000	4,237	2,000	16,237
Nellore	20,000	45,000	30,000	95,000
Cuddapah	...	...	15,000	15,000
Kurnool	...	...	...	...
Anantapur Bellary	...	15,000	40,000	55,000
Salem	50,000	25,000	40,031	1,15,031
Coimbatore	...	...	...	...
North Arcot	40,000	35,000	60,000	1,35,000
Chingleput	60,169	50,000	40,000	1,50,169
South Arcot	20,000	14,000	5,000	39,000
Tanjore	8,000	10,000	5,000	23,000
Trichinopoly	...	...	...	...
Madura	60,000	50,000	31,000	1,41,000
Tinnevelly	60,000	60,000	60,000	1,80,000
Total	3,32,169	3,09,237	3,32,531	9,73,937

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1. *Q.* (*The President.*)—You are specially employed on the Tank Restoration Scheme?—Yes.

2. *Q.* Have you long been in charge of it?—For the past sixteen months.

3. *Q.* Are you an Executive Engineer in the Public Works Department?—I am an Executive Engineer, temporary rank.

4. *Q.* What were you doing before?—I was in the Kistna Northern Division, where I officiated as Executive Engineer for sixteen months; and before that I was Sub-Divisional Officer.

5. *Q.* You say in your note "the object of the Tank Restoration Scheme is to systematically investigate the position and requirements of each irrigation work with reference to the irrigation works above and below it, lay down a standard of efficiency for each work, collect financial and hydraulic details of the same, bring each work to the standard of efficiency and to record the information collected for the future guidance of the officers of the Revenue and Public Works Departments." That is a comprehensive description. When you finish any tank, do you inform the Executive Engineer of the result?—No; we prepare estimates, and these are sent to the Superintending Engineer for execution.

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6. *Q.* Are these estimates all for individual tanks or systems of tanks?—Individual tanks.

7. *Q.* The scheme has been going on for a number of years?—Yes, for the past eighteen years.

8. *Q.* Do you think it will go on for many more years?—Unless we have more funds, it will have to go on for twenty-two years more, I calculate.

9. *Q.* It has been very up and down in its funds?—Yes.

10. *Q.* May I gather from Table A in your evidence that, the expected revenue after improvements being Rs. 34,81,295 and the average collection of revenue before investigation being Rs. 30,31,503, there is expected to be a gain of about 4·5 lakhs on Rs. 53,09,876, the cost of improvements?—These are only approximate figures.

11. *Q.* Column 9 shows the expected revenue; is that the revenue of the *ayakat*?—Very often the full *ayakat* is not irrigated, and very often it cannot be irrigated, because the tanks have silted up.

12. *Q.* Would you spend money on a tank that was not fit for holding water?—No.

13. *Q.* This figure in column 9 is called "the expected revenue after improvements"; is there any grave reason why that revenue should not be realised? Is the figure an outside one?—These figures were furnished by the Collectors of the different districts.

14. *Q.* Are these genuine figures?—Possibly in former years these *ayakats* were irrigated; it is assumed that when the tanks are restored they will irrigate the *ayakat* again, but this is not always the case, as some of the tanks have deteriorated so much.

15. *Q.* When you report on a tank, do you give any indication that the tank cannot be expected to irrigate the same area as before?—We fix the capacity of the tank as near as possible at its former dimensions.

16. *Q.* Is that the theoretical or *bonâ fide* capacity?—It is the actual capacity of the tank, approximately.

17. *Q.* As the tank is now?—Yes.

18. *Q.* Don't you calculate the *ayakat* from that?—We take the average for the past five years and work upon that; as a rule, our estimates don't exceed five years' revenue on that *ayakat*.

19. *Q.* As I understand it, column 9 represents the average revenue for the previous five years?—No; that is not the case.

20. *Q.* What is the value of the improvements?—We cannot give the actual figures of increase of revenue.

21. *Q.* Can you give approximate figures. I take the 34 lakhs given in column 9 as the expected revenue after improvements; then I take column 5, which shows 30 lakhs, as the average collection of revenue before investigation. I assume that the difference represents the value of your improvements; is that not so?—In many cases the full *ayakat*, as given in column 8, cannot be irrigated.

22. *Q.* It was irrigated in the past five years?—No; these are the areas that will be irrigated after improvements.

23. *Q.* Upon what is column 8 based?—The figures are supplied by the Revenue Department.

24. *Q.* (*Mr. Ibbetson.*)—Your works have been going on for eighteen years; have no measures been taken to find out what the actual results have been?—Yes, please see page 127 of Mr. Clerk's book.

25. *Q.* Have you any figures showing the actual area that has been irrigated by each tank that has been restored?—No; no attempt has been made that way.

26. *Q.* (*The President.*)—If you had to defend the position as to whether this scheme is paying or not, how would you do it?—I don't think it should be considered in that light; it has prevented retrogression; if the works had not been carried out, all the tanks would have been in a very bad state of repair.

27. *Q.* (*Mr. Ibbetson.*)—Has any attempt been made to estimate the value of the retrogression, to calculate the financial results by direct or indirect improvement?—The figures are in the office of the Board of Revenue; I have not got them; you would have to get the date on which each of the tanks was completed, so that it would take a long time; very often there is a lapse of some years from the commencement of operations to their completion.

28. *Q.* (*The President.*)—You say the efficiency of the works could be improved if more funds were made available. But it is rather the aim of the Tank Restoration Scheme to bring works to their normal standard of efficiency. That does not necessarily mean that a tank would be made larger than before?—We don't increase the efficiency; we keep to the same.

29. *Q.* Supposing that you found a tank in a series was much larger than it should be, would you cut down the waste weir. Some witnesses have said that complaints have been made that the waste weir was reduced?—We never reduce the capacity as a rule. Very often disputes arise between the rayats along the waterspread; they say that the weir level is too high; in that case we reduce it after consultation with the Collector.

30. *Q.* You don't change the level of the waste weir with reference to the position of a tank in a series?—No.

31. *Q.* If you found a tank undoubtedly injuring a man's land on the margin by the high waste water?—Then we should allow for compensation for the rayat.

32. *Q.* Instead of altering the waste weir?—Yes.

33. *Q.* Supposing you found that a tank might be increased in size without harming any person's land, would that be carried out?—That is beyond the scope of the Tank Restoration Scheme; we don't go in for extensions.

34. *Q.* Not even if there was a clear advantage by the extension?—Yes, in special cases we do, but not as a rule.

35. *Q.* Should it not be a standing injunction to any officer carrying out a scheme, that if he saw a very advantageous position for increasing irrigation, he should recommend it?—Yes, certainly.

36. *Q.* You make over your estimates and plans to the Executive Engineers of the different districts through the Superintending Engineers concerned?—Yes, and they carry them out.

37. *Q.* Is it their business to carry them out without making any change one way or another?—They often send in revised estimates; they simply alter the rates.

38. *Q.* (*Mr. Higham.*)—When a minor basin has been completely restored, I believe a record is maintained?—Yes.

39. *Q.* Have you got any specimens of the record here?—There are copies in the office of the Board of Revenue.

40. *Q.* Has the Executive Engineer a copy?—Yes, the Executive Engineer, the Collector, and the Sub-divisional Officer; also the Chief Engineer.

41. *Q.* How many copies are printed?—It varies according to the number of Sub-divisional Officers and Divisional Officers.

42. *Q.* I don't quite understand what your own duties are in regard to tank restoration?—I have to scrutinize the estimates and see that the proposals made are suitable.

43. *Q.* That is, the proposal made by the parties in the field?—The parties submit estimates to the office and there they are scrutinized.

44. *Q.* How many parties are there?—Six.

45. *Q.* How are they made up?—The parties consist of one Sub-Engineer or Supervisor, four Sub-Overseers, three draftsmen, and two clerks.

46. *Q.* They send in their reports to you?—Yes.

47. *Q.* How do you scrutinize them?—I go through them in the office, and I take some of the estimates; I cannot check them all on the spot; I select a few and compare them with details on the ground.

48. *Q.* Do you go out and inspect the party?—Yes.

49. *Q.* Do they send in estimates one by one or for the whole drainage line at once?—They send them in at irregular intervals; they are supposed to send in a certain number aggregating Rs. 6,000 a month.

50. *Q.* (*Mr. Ibbetson.*)—Is that each party?—Yes.

51. *Q.* (*Mr. Higham.*)—If you thought some examination on the ground was necessary, what would you do?—I should put it on one side and inspect the tank.

52. *Q.* Are the estimates finally put into print?—No; they are kept in manuscript.

53. *Q.* Are the estimates passed by you?—Important estimates or those for the larger works are sent to the Chief Engineer.

54. *Q.* When the estimates come to you, you don't sanction them?—I simply scrutinize them and pass them on.

55. *Q.* I suppose sanction is accorded afterwards?—They are sanctioned in the office after scrutiny, and then they are sent to the Superintending Engineer for execution.

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56. *Q*. As funds permit ?—Yes.

57. *Q*. Practically you sanction all up to a certain amount ? —Yes.

58. *Q*. Up to what amount ? —Rs. 2,000 or more if there are no difficulties; very often only the *bund* requires raising; they are not sent to the Chief Engineer unless they involve some difficulty.

59. *Q*. The amount has nothing to do with it ?—Not as a rule.

60. *Q*. Is the local Executive Engineer ever consulted about these estimates before they are passed ?—He is if he has taken up work, that we are investigating; very often we start an investigation of a work that has been taken up by him; in that case he is consulted.

61. *Q*. We have had a witness saying that these estimates are sanctioned without being scrutinized by the local officers, and that they are drawn up on rather hard-and-fast lines ?—I don't think the Executive Engineers have time to inspect all these works.

62. *Q*. Have you hard-and-fast rules for regulating this ?—We have certain rules to act as guides for subordinates, otherwise we should have to prepare the estimates again in the Central Office; the rules are not hard-and-fast.

63. *Q*. (Mr. Pears' case read out) ?—That is an extreme case that happened in 1896; before there was a special officer in charge of the Tank Restoration Scheme.

64. *Q*. (*Mr. Ibbetson.*)—Who was in charge ?—The Assistant Chief Engineer for Irrigation; he had no time to inspect the works.

65. *Q* (*Mr. Higham.*)—You don't think a case of this kind is likely to occur now ?—I try to avoid them.

66. *Q* You don't think any special measures are necessary to prevent that state of things ?—No; there is more time for scrutiny.

67. *Q*. The question is whether you can go out and see things ?—It is not possible for me to see them all; I take them up at random and check them.

68. *Q* Are all these works carried out by the Revenue or Public Works Department ?—By the Public Works Department.

69. *Q*. Are there any charges made against the restoration works for the establishment employed on them ?—The ordinary charges—23 per cent. for establishment and 1½ per cent. for tools and plant.

70. *Q*. Do the figures in the statement here include establishment ? —Some of them do; it is noted at the end.

71. *Q*. Column 3 in statement C; does that include cost of establishment ?—Yes.

72. *Q*. After a tank has once been brought to efficiency under the Tank Restoration Scheme, is any record kept of the sums spent on it ?—Not separately; that is shown as an ordinary work.

73. *Q*. Quite separate from the Restoration Scheme ?—The Tank Restoration Scheme has only to bring it to a proper standard of efficiency.

74. *Q*. After that a certain amount of expenditure is incurred occasionally on repairs; is no record kept of that ?—It is included under minor works, not separately.

75. *Q*. Is there any means of ascertaining the cost of repairs to tanks that have once been restored ?—It is not kept separately; it would be long and tedious work to get out these details.

76. *Q*. Is it impossible to form any idea of what it will amount to ?—It could be arrived at.

77. *Q*. I understand Government sanction large sums for the restoration of these tanks; the question has never been satisfactorily settled as to how the tanks should be kept in order if they have been restored; could any idea be given of the cost of keeping them in order ?—Do you mean for the maintenance of tanks that have been restored ?

78. *Q*. Yes, so as to prevent retrogression after they have once been repaired ?—I should think an expenditure of 12 annas on an acre irrigated under each tank would be sufficient annually.

79. *Q*. Do you think it would cost as much as that ?—I think so.

80. *Q*. After a tank had been put in order, you could repair it at intervals of five years, and a sum might be taken equivalent to 12 annas an acre. Supposing it were proposed to recover from the owners of tanks a cess annually that would cover all repairs, would it amount to 12 annas an acre ?—Yes.

81. *Q*. How do you come by that; is it just a guess ?—Judging from the cost of maintenance of ordinary irrigation works, all these works are scattered.

82. *Q*. What is the ordinary cost of repairs of tanks; does that come to 12 annas an acre ?—It is given in detail in the Chief Engineer's note; I have no figures.

83. *Q* I understand you to say that the main object is to prevent retrogression ?—Yes.

84. *Q*. Well, two-thirds of the total area that is dependent on the tanks still remains to be investigated ?—Yes.

85. *Q*. In how many years has one-third been investigated ?—In eighteen years.

86. *Q* At that rate of progress a great many of these tanks will not be investigated for thirty years ?—We are progressing faster now than we did at the beginning, so that it will take 20 to 25 years to complete.

87. *Q* Meanwhile will not a great many of these tanks have deteriorated a great deal ?—Certainly.

88. *Q*. Do you think it would be desirable to have a higher rate of progress ?—No doubt it would; the longer you leave it the more money you will have to spend.

89. *Q*. What is the rate of progress limited by ?—Want of funds.

90. *Q*. Want of funds only. Supposing you had as much funds as you could spend, would there be any other limit ?—You would have to increase the establishment.

91. *Q*. You are still investigating a great deal faster than you are repairing; on that account you reduce the rate of investigation ?—It has been reduced from time to time; in the last four years the same establishment has been employed in investigation; consequently we are about 11 lakhs ahead of execution.

92. *Q*. During the last year you have lost ground considerably ?—Yes.

93. *Q*. Would it not be possible to equalize the rate of execution and the rate of investigation ? —Yes; if it is necessary to repair a work at all, it should be done as soon as possible.

94. *Q*. Has it happened that you have investigated a project, and that it has been pigeon-holed for some years before being carried out ? —Yes.

95. *Q*. What is the present annual expenditure ?—About 3½ lakhs.

96. *Q*. What is that on ? —Execution of estimates already investigated.

97. *Q*. And on investigation ?—Rs. 59,000.

98. *Q*. Taking the two together, it is about 4 to 5 lakhs on investigation and execution ?—Yes.

99. *Q*. You say towards the end of your note "the efficiency of the works could be improved if more funds were made available; but it is rather the aim of the Tank Restoration Scheme to bring works to their normal standard of efficiency to which they were originally designed as nearly as can be, allowing the ordinary divisions to deal with the increase of efficiency." I understand from that that you don't intend to improve or enlarge the efficiency of the tanks ?—No.

100. *Q*. Any work that would have that effect is taken up by whom ?—The Divisional Officer.

101. *Q*. So that all you aim at is to keep them at a normal standard ?—Yes.

102. *Q*. In regard to the average area cultivated, which you have given in column 4 of statement A, is that what you call the *ayakat* of the tank ?—No; it is the average for five years actually cultivated.

103. *Q*. On these works there is a consolidated revenue; is there not; is the cultivated area actually measured every year ? —That is a revenue matter; I cannot answer the question.

Mr. Nicholson explained that the assessment varies on every field; in tanks of 100 acres 80 may be held one year and 70 in another. If there is water, holders will be charged.

104. *Q*. (*Mr. Rajaratna Mudaliar.*) —Under your tank investigation scheme, do you not determine the existing capacity of each tank ?—Yes.

105. *Q*. That is your first step ?—The first step is to fix full tank level.

106. *Q*. Having determined that, that data coupled with the average area cultivated during the previous five years will enable you to find out the duty under existing conditions ? You know the existing capacity of the tank and the

average area cultivated during the previous five years. You therefore know the duty approximately?—It does not follow. We know how many cubic feet of water are required to irrigate an acre.

107. *Q.* We assume that the area irrigated for five years will enable you to find out the irrigating capacity of the tank?—The tank may have to fill twice or only once to irrigate the full *ayakat.*

108. *Q.* But that does not matter. What I want to find out is having determined the existing capacity and the future capacity when the tank is restored, will you not be able to fix the *ayakat*?—We only take the capacity of the tank when it is restored. After ascertaining the full tank level we find out the capacity.

109. *Q.* You know the existing capacity; don't you?—That is not worked out.

110. *Q.* That is not a part of your scheme?—No. We work out the capacity from the full tank level.

111. *Q.* (*The President.*)—It is perfectly simple to work it out?—You can work it out. We work out the capacity from the full tank level that we fixed.

112. *Q.* (*Mr. Rajaratna Mudaliar.*)—In that way you could determine what area the tank would irrigate when it is restored?—Yes.

113. *Q.* Don't you think, considering the enormous expenditure, it is desirable to know the extent to which revenue will be rendered safe and increased and improved also?—It would be a good thing to know. There are so many conditions.

114. *Q.* What is the difficulty in taking steps to ensure such a record being maintained for each work?—The Revenue Department could easily do it if arrangements are made. There will be no difficulty, I suppose?—We have to take into account the remission for each year and the state of the season.

115. *Q.* (*The President.*)—From your present information, have you no means of saying that such and such a tank does double the duty of another tank. Have you no means of differentiating one from another?—We take the capacity of each tank.

116. *Q.* I presume there is great difference?—Yes.

117. *Q.* (*Mr. Rajaratna Mudaliar.*)—Of the tanks restored, can you say how many irrigate less than fifty acres?—There is no account kept. From a recent Government order I think the number is about 20,000.

118. *Q.* Of the tanks restored?—We have got no accounts.

119. *Q.* You have altogether restored about 5,000 tanks?—Yes.

120. *Q.* Of these you do not know how many irrigate less than 50 acres?—Not without taking each tank and calculating.

121. *Q.* According to your statement, the cost of repairing these works works out to Rs. 1,312 for each work. Taking 5,000 works as having been improved (that is in column 6 of statement A) and the cost of execution (the last column in statement C) as Rs. 65,61,000; the cost of each work restored works out to Rs. 1,312. Do you think I am correct in drawing that inference? That is the average cost of each work?—The Rs. 65,61,000 includes establishment charges and tools. Without these the amount is Rs. 53,00,000.

122. *Q.* Without that it works out to a little over Rs. 1,000 each?—Yes.

123. *Q.* The cost of investigation comes to Rs. 250 for each work. That is, the number of works under investigation is 6,296 (column 3, statement A), the cost of investigation Rs. 15,99,000 (statement C); dividing one by the other, you get Rs. 250 for each?—Yes.

124. *Q.* Do you not think it is possible to reduce the cost of investigation and execution, considering that most of the tanks irrigate less than 50 acres?—I do not think that most of the tanks irrigate less than 50 acres. More than half the number of tanks irrigate more than 50 acres. The total number of tanks is 50,000, of which 20,000 irrigate less than 50 acres.

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125. *Q.* Considering the nature of the work to be done and the nature of the investigation, do you think the cost could be materially reduced under some proper system?—If lower standards were laid down for each tank.

126. *Q.* You have seen Mr. Pears' remarks. What do you mean by a lower standard?—To make the ***bund*** of the tanks at a certain height above full tank level, according to the depth and width of the waterspread.

127. *Q.* You do this work when there is need for it, not as Mr. Pears puts it whether there is need or not?—As far as possible when there is need.

128. *Q.* How could you lower the standard?—In cases where it is now considered necessary to make a *bund* 4½ feet above the full tank level, we could make it 3 feet.

129. *Q.* Do you think the system can be worked better and more economically if the investigation party be placed under the supervision of the Executive Engineer of each division?—I do not think the Executive Engineer has time to look after the investigation party.

130. *Q.* He is on the spot; he will be able to exercise better supervision; will he not?—Yes, if he was able to move round and see and inspect all the works. But he has his ordinary work to do. That is why the Tank Restoration Scheme was inaugurated as separate from the ordinary work of the division.

131. *Q.* Is he able to carry out the restoration work without additional establishment; in the majority of cases he is, I suppose?—He is, under the present circumstances. If increased funds were given, the Tank Restoration establishment would have to be increased.

132. *Q.* If more funds were available for the investigating party, you can have the work done economically?—I think there will be considerable reduction in the total cost, if the works were carried out rapidly by allotting more funds.

133. *Q.* In your note you say "the efficiency of the works could be improved if more funds were made available." What do you mean by the statement that the efficiency of the works could be improved?—The increase of capacity is a question that we do not deal with. Supplies to certain tanks from rivers also are not taken into consideration. We do not take up such questions.

134. *Q.* (*The President.*)—If an officer sees a distinct and increasing advantage by the construction of a tank, he calls the attention of the Executive Engineer to it, I suppose?—Yes.

135. *Q.* (*Mr. Rajaratna Mudaliar.*).—Is there anything to prohibit your making an investigation?—No, except that it delays the ordinary works of repair.

136. *Q.* That is not a matter of consequence considering the improved efficiency of the work?—In eighteen years we have only gone through a third of the number of works, or one-third of the area under the works.

137. *Q.* (*The President.*)—As things now stand, allotments for actually carrying out the works you recommend follow so tardily that you might knock out the establishment for two or three years and wait for the working party to overtake you?—Yes.

138. *Q.* (*Mr. Rajaratna Mudaliar.*)—You can carry out investigations so as to include improvements?—That will delay ordinary repair work.

139. *Q.* There is no use your going far ahead. You have nothing to do with the execution of repairs. You go on only with the investigation; the repair is done by another party?—Yes.

140. *Q.* So, why should you go so far ahead of the party entrusted with the execution of the work? Why should you not confine your work to calculating and making your investigations so as to include improvements?—That will be all right until execution is on a level with investigation, but after that investigation would get behind.

141. *Q.* As matters stand at present, it will be a long time before the two parties will come up to that standard?—If the investigation work were stopped now, it would take over three years for execution to catch up.

142. *Q.* So far as investigation has gone on?—Yes. After three years, more investigation will have to take place. There should be a margin between investigation and execution.

Colonel A. W. Smart, R.E., Acting Chief Engineer for Irrigation.

(Madras, 13th February 1902.)

(Answers to Questions for Public Works officers.)

Colonel A. W. Smart.

Preliminary.—Protection against drought by *irrigation* may be either direct or indirect; indirect by increasing the surplus produce of tracts where irrigation facilities are greatest or where the people are more alive to the benefits conferred thereby and will at once when water is brought to them utilise it to the fullest extent; direct by saving the crop on the ground, ordinarily unirrigated, in a season when there is a partial or total failure of the monsoon rains. The increase of the surplus produce in a tract of country is perhaps of as much importance as saving the crop in a bad year and is in most cases easier to effect. The large and small schemes of irrigation which will certainly increase the produce and will be directly remunerative to the State come under the term "productive." Schemes to save a crop on the ground cannot be regarded as directly remunerative but must be undertaken simply to protect the poorer classes, whose imprudent habits and scanty means always keep them on the borders of subsistence and leave no margin to meet a partial or total loss of crop. In a great famine, such as that of 1876, about 30 per cent. of the population of a seriously affected district will come on the relief works; as about 80 per cent. depends on agriculture, it may be taken that 40 to 50 per cent. of the agricultural classes will at such a time be forced to seek State or other relief; the other half will, by living on capital saved in more prosperous years, be able to exist through the time of famine with more or less suffering without seeking relief. Fortunately there are districts or tracts in this Presidency which are more or less secured against famine and a failure of rain is not general in any one year over the whole area of even those districts which are chiefly dependent on the local rains. As regards protection, pure and simple, what is the nature of the problem to be solved? The cultivating season of the south of India may broadly be said to extend from the middle of June to the end of December, that is, through the rains of the south-west and north-east monsoons. If the rains do not fail and are fairly distributed, the single crop on unirrigated land that may be harvested during this time will be good and abundant. Loss will be partial or total according as one or the other monsoon fails. If the failure is complete, as it was in some areas during the year 1876-77, famine in such tracts will be intensified more or less complete. If full protection is desired that quantity of water which the rain fails to give must be restored by irrigation. Taking the district of Cuddapah, we find that in the year 1876 the actual rainfall was 8·20 inches against an average of 29·12, a deficiency of 21 inches. There were, in 1876, 18 wet days against an average of 42. To restore the balance would have required from the time that sowing is most active and during the time of growth in the latter half of August 2 inches, in September 5 inches, in October 6 inches, in November 5 inches, and in the first fortnight of December 2 inches. It is certain that there would have been an excellent harvest if a watering had been given once a fortnight from 15th August to 15th December, or eight waterings in all of 2 inches each. This is the quantity that would be required to give a bumper harvest of cholam, (rain-fed) paddy, cotton or ragi; for inferior grains as millet, cumbu, gram, red-gram, etc., 1 inch of water once a fortnight would have afforded protection. It is estimated that half the water required for a full crop or 1 inch watering once a fortnight for the more valuable food-grains would be sufficient to save a crop though not give a full harvest; including absorption and evaporation we may say that 1½ inches should be given by channel or well irrigation once a fortnight from 15th August to 15th December to afford good protection or roughly 40,000 cubic feet of water is required per acre for a six-month and 20,000 cubic feet for a three-month crop. Fortunately, however, even in the worst years the rain does not completely fail, so that for irrigation of dry crop in seriously affected districts 10,000 cubic feet should suffice from artificial sources, whether a well or a canal, to save a three or a four-month crop on the ground. In the case of cotton and such hardy plants as gram 5,000 cubic feet may be found sufficient. What are the areas for which such protection should be, if possible, afforded? Appendix A and diagram give the areas of Government occupied, cultivated and irrigated land in all the districts of the Presidency save the West Coast. It will be seen at a glance that the areas now irrigated in the districts most liable to drought are a small percentage of the areas cultivated. In Bellary the percentage is only 0·03 and in Anantapur 0·10. It becomes obvious, as possibilities of irrigation under proposed projects and under wells are studied, that even partial protection in the zone liable to famine is impossible unless it largely takes the form of irrigating dry crop. In this Presidency, unfortunately, irrigation, except under wells and in a few exceptional cases, has been restricted to rice which requires at least four times the amount of water required for any dry crop. Major-General Cotton says in his recent pamphlet: "It has been a misfortune to the south of India that the word 'irrigation' implies rice cultivation and that the water is paid for by the acre and not by the quantity used. With an unlimited supply the most profitable crop is rice. This crop is the most unprofitable to those who have to supply the water. This is well understood by the native cultivators who, when they use water from a well and have the expense of lifting it, do not grow rice, but such grains and other produce as only require occasional watering." In the ceded districts especially, the cultivation of rice should not be fostered; and if water is given for it, it should be on the distinct understanding that dry crop will have the preference, and during a time of drought, the water will be distributed over the greatest possible area of dry crop with the view of saving it. Where the supply of water is limited, this is the only possible method of protection by irrigation. It may be taken generally that the water required for one acre of rice will irrigate 4 acres of dry crop. The wet-rate is generally taken at Rs. 4 per acre; a tax of Rs. 1-4-0 to Rs. 1-8-0 may be levied on an acre of dry crop irrigated or, say, Rs. 5 for 4 acres dry instead of Rs. 4 for one acre of rice. The distributaries for the dry crop will be of greater length and the additional one rupee will meet the interest on the extra capital expenditure on distributaries. If dry crop were to be irrigated regularly, the direct return to Government would be about the same as for rice and the benefit to the people much greater.

2. If the Commission is not already convinced that in future the indirect gains of irrigation should be much more considered than has been the case in the past and that the rule whereby a work may not be classed as "productive" unless it pays directly 3¼ to 4 per cent. on the capital cost should be abolished or very considerably modified, it is advisable to direct an inquiry by an experienced finance officer into the question of relative gains—direct or indirect—due to works of irrigation, in such districts as the Godavari, Kistna, Tanjore, Nellore, Madura, Ganjam, and even in Kurnool and Cuddapah partly served by the Kurnool-Cuddapah Canal which has been regarded as a financial failure. The indirect gains will be found to be much greater than is often supposed and the result of the inquiry will probably bring works under the term "productive" that simply pay their working expenses. There are also moral and political gains to be considered on which no money value can be placed.

The Famine Commission of 1879 placed on record the following:—

> "It has been too much the custom in discussions as to the policy of constructing such works to measure their value by their financial success, considered only with reference to the net return to Government on the capital invested in them. The true value of irrigation works is to be judged very differently. First must be reckoned the direct protection afforded by them in years of drought, by the saving of human life, by the avoidance of the loss of revenue remitted, and of the outlay incurred in costly measures of relief."

3. As the construction of several reservoirs on main rivers is proposed, it is hoped that the silt objection, which has recently come into prominence in the controversy regarding the Bhavani and Cauvery irrigation schemes, will be considered by the Commission.

The Inspector-General of Irrigation (Mr. Higham) holds that in the case of the Cauvery with a reservoir of the Nile type the deposit may be 20 millions cubic feet with an average annual discharge of 300,000 millions cubic feet, but that the quantity will not prejudicially affect the life of the reservoir for several centuries to come and may, for the present, be neglected. The question, however, as to the value of the silt that will be deposited as manure is still an open question and is to be made the subject of further investigation. (Incidentally I may remark that my calculations as to the quantity that may be best abstracted from the lands of Tanjore have been questioned. A little further investigation will show that my calculations if incorrect err on the side of safety.) This part of the silt objection, however, is a veritable bogey and the sooner it is laid the better. If the velocity through the reservoir is equal to or greater than the velocity with which the water arrives on the fields, the silt deposited in the reservoir will not, either in fineness of

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quality, be the silt that is required on the fields—that is not the silt that fertilises. It is quite possible that where warping is still in progress, in swamps for instance in the lower part of the delta, some of the silt which has hitherto reached these tracts at velocities of over 1 foot a second may be stopped by a reservoir and the process of warping may become slower.

Again, when fields have been formed by deltaic deposits, the subsoil tends to become impervious and very little of the silt that reaches the fields is there deposited but flows off with the escaping water. If it were not so, the fields would in course of time rise too high for efficient supply. This fact is brought to notice in Agricultural Ledger No. 11893 on Silt Deposits—see page 3 where it is stated—"The silt deposit proceeds much faster at first when the water sinks directly through the gravel which acts as a filter. By degrees this filtration causes a nearly impermeable bed, through which very little of the water escapes, and just so much the more flows off by the drainage lines, and flows off without having entirely divested itself of its particles of mud. Were it not for this the meadows would rise higher each year and soon be above the water's reach, but it is found that after a few years there is no sensible change in their level, and what is deposited by fresh silt only makes good what is consumed on the vegetation."

The main thing required in India is to store water for extending irrigation. If a reservoir is found in practice to intercept *fertilising* silt, it rests with Engineers to find the remedy. No reservoir should be condemned on this ground; it would be a public calamity in a tropical climate like India to condemn the construction of any reservoir on a main river for such a reason. The remedy that obviously suggests itself is to discharge the flood water, that is, water with silt at a maximum, through the sluices with the smallest possible head and to fill up as the flood falls. A little study of the question will show that this may be accomplished in almost any possible case. If after this the deposit is found to contain fertilising material, the loss of which has been proved to be detrimental to the fields which previously received it, then it may be necessary to resort to mechanical or other methods. This adds no doubt to the cost of maintenance, but will be after all only a fraction of the value of water.

3. (*a*) We know that most reservoirs, if not all, gradually silt up in process of time. The question, however, that we must ask, as the prime necessity is the water that may be stored, is what will their life be. What work will they do before their capacity is seriously impaired? This may be illustrated by the Cauvery case, with a proposed reservoir capacity of 30,000 millions cubic feet. I have shown elsewhere that if every particle of silt were deposited (which is impossible with a dam of the Nile type) that it would take 500 years to reduce it to the working capacity of the Bhavani (27,000 millions cubic feet). But assume that the conditions are different and that the Cauvery reservoir would be seriously injured in 200 years' time. The cost of the reservoir will be, say, 100 lakhs; the annual revenue derivable therefrom 10 lakhs; (the distributary works below costing 50 lakhs will remain uninjured); total revenue in 200 years 2,000 lakhs. At the end of the second century the reservoir might be removed and another one built in another place and yet the gain would be great. Or deducting the interest charges on 100 lakhs at 4 per cent.—4 lakhs—we should have a yearly revenue of 6 lakhs or 1,200 lakhs in 200 years. The indirect gains to the Government may at least be placed at another 1,200 lakhs, so that at the end of 200 years we have gained for the State 2,400 lakhs and have to build another reservoir to replace the injured one at a cost of 100 lakhs. And is no account to be taken of the gains to the people? Of the large increased surplus produce?

4. *Lift irrigation.*—Where irrigation by direct flow is impossible, it will be necessary in many cases, if protection is to be afforded, to resort to lift irrigation by steam-pumping or otherwise. One such scheme has been worked out and will be shortly placed before Government. I refer to the Divi pumping scheme for the irrigation of 50,000 acres, which seems certain to be a success and which will, I hope, be executed at an early date. There are similar schemes possible in the Kistna, Godavari and other districts, which, however, require investigation before anything definite can be said about them. Small pumping schemes from infiltration wells, whether in the beds of rivers or elsewhere, are possible in many places, but whether they would pay or not remains to be proved by investigation and trial. It is advisable, before embarking on a large scale on such minor schemes, to put up oil-engines and pumps in a few selected places in different districts where one cusec or more is obtainable in order to give the method an exhaustive trial. It may be taken that one cusec would be sufficient to irrigate 250 acres of dry crop. But for the enormous areas that have to be protected where projects are impossible, surface wells irrigating from 3 to 5 acres are alone possible. Objection has been taken to such wells that they fail or are liable to fail during times of drought. There is, no doubt, some truth in this with regard to certain tracts but is not universally or generally true. The importance of well irrigation as it exists and of its extension by every possible means is very great. It would be interesting to ascertain to what extent rayats depending on well irrigation have, in the past, been obliged in times of drought to fall back on relief works on account of failure of their wells. The number would probably be found to be very small. In ordinary years the produce under well irrigation is very considerable, and gives a reserve of capital on which the rayat may live during a time of famine even if his well fails at the critical time. His ability to resist famine is very much strengthened by the possession of a well and on account of the labour entailed leads to the formation of a habit of thrift. No irrigation work, whether great or small, should be condemned because it may fail once in five or six years. Five good years will enable a thrifty rayat to tide over the year of failure with the least possible suffering.

There are numerous and obvious objections to Government undertaking as a general principle the construction of surface wells in private lands, but it is possible, however, to devise a scheme which will give better results than the present one of *takavi* advances and in backward districts, such as Bellary and Anantapur, the Government must be prepared to spend considerable sums as grant-in-aid if well irrigation is to extend considerably to meet the wants of the people. The Government should undertake a hydrographic survey of each district, such as that made by the hydrographic section of the Geological Department in the United States, beginning with the most backward. A perusal of the reports of that department should convince the most sceptical that such a survey will prove of very great value in this country also and enable schemes of irrigation and pumping to be inaugurated with greater prospect of success than is now possible.

5. It would be an anachronism to revive the old controversy of Canal *versus* Railway, but it will probably be conceded that the railway policy has led to an expenditure in India incommensurate in many parts with increase of produce and that it is now time not perhaps to reverse the railway policy and to stop the construction of railways but to very largely increase the expenditure on canal and irrigation works. In a tropical country like India, with undeveloped resources and subject at intervals to severe famines, it is surely wrong to spend yearly 1 million on irrigation works and 10 millions on railways. An irrigation project takes much longer than a railway project to investigate and mature, and no doubt this has had something to do with the rapid development of railways in India. A perusal of Mr. Clerk's report will show how backward investigation is; there is hardly a project mentioned there of any consequence which has yet been adequately investigated; of each district we know something but not enough. Investigation then must be the key-note of the irrigation policy for the next few years, but much may be immediately done in the actual execution of minor projects, trial pumping schemes and well irrigation. It is hoped that there is sufficient evidence before the Commission to enable it to arrive at the conclusion that large irrigation projects in the Southern Presidency are still possible and that much may be done in each district to give fair, if not full, protection against drought. It is impossible to hope that protection will ever be complete, for there is always a large residue especially in the famine zone living on the borders of starvation which begins to suffer at a small rise in price of food-grains and in times of actual scarcity must resort to Government relief works. Protection by irrigation of dry crop under canals and wells will, however, very considerably reduce the residue and the powers of resistance of the agricultural classes generally will be greatly increased.

Colonel
A. W. Smart

6. The following statement is of interest as showing how successful the Madras works have been:—

Statement showing the general financial results of irrigation works in India to the end of 1899-1900.
(*Minor works for which Capital and Revenue Accounts are not kept* excluded.)

—	TOTAL CAPITAL OUTLAY, DIRECT AND INDIRECT.					REVENUE IN EXCESS OF WORKING EXPENSES AND INTEREST REALISED IN PAST YEARS.					NET SUM OF CHARGE.				
	MAJOR WORKS.			Minor works for which Capital and Revenue Accounts are kept.	Grand Total.	MAJOR WORKS.			Minor works for which Capital and Revenue Accounts are kept.	Grand Total.	MAJOR WORKS.			Minor works for which Capital and Revenue Accounts are kept.	Grand Total.
	Productive.	Protective.	Total.			Productive.	Protective.	Total.			Productive.	Protective.	Total.		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Lakhs.	Lakhs	Lakhs.	Lakhs.	Lakhs.	Lakhs.	Lakhs.	Lakhs.	Lakhs.	Lakhs.	Lakhs.	Lakhs	Lakhs.	Lakhs.	Lakhs.
Bengal	643	...	643	117	760	—575	...	—575	79	—496	1,218	...	1,218	38	1,256
North-Western Provinces and Oudh	828	44	872	29	901	237	—29	208	—7	201	591	73	664	36	700
Punjab	903	41	944	27	971	425	— 4	421	77	498	478	45	523	— 50	473
Madras*	†673	47	720	95	815	‡643	—12	631	101	732	30	59	89	— 6	83
Bombay	288	86	374	112	486	—39	—44	—83	88	5	327	130	457	24	481
TOTAL	3,335	218	3,553	380	3,933	691	—89	602	338	940	2,644	307	2,951	42	2,993

* Figures relating to purely navigation canals under Minor Works for which Capital and Revenue Accounts are kept have been excluded.
† Includes Rs 217 lakhs, the price of the Kurnool-Cuddapah Canal.
‡ Includes an excess charge of 149 lakhs on account of the Kurnool-Cuddapah Canal.

7. The following statements give the revenue under different heads for a series of years for the districts of Godavari, Nellore, and Ganjam:—

Statement showing the Revenue under different heads in the district of Godavari for a series of years from 1850-51.

Years.	I Land Revenue.			IV. Stamps.			V. Excise.§			VII Customs			VIII. Assessed Taxes.			X. Registration.			XI. Tributes.			Collection under all heads of Revenue.
	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.
1850-51	19,72,881	0	0	16,562	0	0	56,089	0	0	37,830	0	0	...			...			...			24,19,756
1851-52	20,25,310	0	0	16,517	0	0	55,214	0	0	39,053	0	0	...			...			...			24,50,406
1852-53	20,22,465	0	0	14,835	0	0	58,588	0	0	47,576	0	0	...			...			...			25,01,963
1853-54	20,18,510	0	0	16,016	0	0	52,732	0	0	40,355	0	0	...			...			...			24,45,199
1854-55	...			...			...			...			...			...			...			25,49,163
1855-56	...			...			...			...			...			...			...			25,65,371
1856-57	...			...			...			...			...			...			...			26,82,468
1857-58	...			...			...			...			...			...			...			26,46,380
1858-59	...			...			...			...			...			...			...			30,23,701
1859-60	...			...			...			...			...			...			...			32,17,044
1860-61	...			...			...			...			...			...			...			41,41,739
1861-62	...			...			...			...			...			...			...			39,22,148
1862-63	...			...			...			...			...			...			...			40,98,076
1863-64	...			...			...			...			...			...			...			41,65,308
1864-65	...			...			...			...			...			...			...			43,47,997
1865-66	...			...			...			...			...			...			...			49,16,951
1866-67	35,12,825	0	0	1,39,798	0	0	...			48,200	0	0	‖55	0	0	...			...			...
1867-68	38,67,333	0	0	1,67,947	0	0	...			79,319	0	0	40,427	0	0	...			...			...
1868-69	34,87,702	0	0	1,85,999	0	0	...			1,00,731	0	0	48,535	0	0	...			...			...
1869-70	41,38,043	0	0	2,06,934	0	0	...			1,11,481	0	0	1,225	0	0	...			...			...
1870-71	38,87,095	0	0	1,98,364	0	0	..			1,28,670	0	0	2,24,594	0	0	...			...			...
1871-72	42,66,508	0	0	2,16,438	0	0	...			94,204	0	0	69,583	0	0	...			...			...
1872-73	39,00,043	0	0	2,21,131	0	0	...			55,236	0	0	33,299	0	0	...			...			...
1873-74	41,50,386	0	0	2,42,845	0	0	...			79,013	0	0	948	0	0	...			...			...
1874-75	42,36,416	0	0	2,79,625	0	0	...			1,60,754	0	0	9	0	0	...			...			...
1875-76	43,63,693	0	0	2,96,449	0	0	...			1,04,886	0	0	...			...			...			...
1876-77	44,86,821	13	1	2,77,084	2	0	3,01,181	1	7	56,869	6	7	...			...			...			...
1877-78	43,17,600	3	2	2,91,619	1	1	2,54,736	5	2	12,843	12	3	...			...			...			...
1878-79	45,10,585	0	8	3,12,965	1	8	4,03,086	0	2	11,187	2	6	74,450	0	5	...			...			...
1879-80	44,56,229	15	5	3,35,627	8	0	3,79,677	15	7	46,310	13	2	77,696	5	3	...			...			...
1880-81	49,64,932	3	10	3,30,700	8	8	4,64,106	7	8	91,249	14	7	30,351	8	0	19,282	13	2	251	9	4	...
1881-82	46,08,277	14	2	3,53,624	13	0	4,39,312	3	5	45,576	7	7	28,188	6	0	31,145	14	0	...			...
1882-83	40,47,668	2	4	3,38,321	8	0	3,04,653	12	9	35,928	4	10	27,937	3	10	30,103	14	10	...			...
1883-84	44,03,206	3	10	3,34,362	4	0	3,61,029	10	8	6,811	2	0	25,337	10	0	33,445	15	5	...			...
1884-85	46,81,597	3	3	3,10,614	4	0	3,66,195	7	3	43,685	10	3	27,786	0	3	38,376	10	7	...			...
1885-86	45 56,271	4	8	3,72,509	6	9	5,39,564	7	3	48,921	9	4	29,291	4	7	46,541	3	10	...			...
1886-87	42,04,846	14	9	3,62,480	10	1	5,40,295	8	0	20,529	5	11	60,762	8	2	48,264	13	3	...			...
1887-88	49,43,098	11	9	3,77,630	13	0	5,72,890	1	10	11,023	6	9	65,338	14	4	53,559	6	9	...			...
1888-89	45,86,669	5	8	3,70,545	11	0	6,25,418	14	10	49,573	10	7	72,004	8	6	52,355	11	0	...			...
1889-90	51,10,426	7	10	3,92,618	15	7	6,32,383	0	2	34,699	14	9	65,559	8	10	56,683	6	5	...			...
1890-91	48,66,433	13	7	3,98,079	9	7	7,53,820	14	3	54,030	0	6	67,917	14	8	61,479	6	9	...			...
1891-92	40,09,326	8	0	4,41,059	0	11	9,05,178	8	4	21,341	13	5	76,746	2	9	64,259	3	11	...			...
1892-93	50,35,372	9	8	4,55,860	4	0	11,87,163	4	10	44,504	11	11	90,425	4	10	65,692	2	0	...			...
1893-94	57,91,069	6	2	4,93,859	12	0	12,69,852	3	1	85,123	10	1	1,16,936	7	8	72,018	4	7	...			...
1894-95	56,27,524	4	11	5,17,198	6	0	13,86,069	11	10	88,799	15	7	1,32,052	13	0	63,610	7	1	...			...
1895-96	52,36,483	6	6	5,57,214	14	0	13,24,425	2	6	64,727	2	9	1,26,579	15	0	68,269	9	6	...			...
1896-97	80,25,264	6	9	5,48,900	5	0	12,17,485	14	7	65,729	12	11	1,28,479	4	3	72,782	8	9	...			...
1897-98	58,92,165	15	5	5,84,506	0	0	12,41,026	13	4	63,409	13	8	1,34,791	15	5	81,746	12	4	...			...
1898-99	59,53,680	4	3	5,68,427	1	6	11,45,182	12	10	1,33,992	0	8	1,45,290	11	7	79,751	8	3	...			...
1899-1900	58,53,947	13	10	5,59,575	9	2	12,93,256	12	6	93,610	5	2	1,53,518	13	0	75,686	11	1	...			...
1900-1901	73,68,611	8	0	5,81,809	10	9	12,26,481	3	4	0	6	0	1,62,848	5	0	86,774	0	6	...			...

§ What was formerly called "Moturpha"

‖ Includes only income and license taxes.

Note.—Godavari anicut works—
Date of commencement—1st March 1847.
,, of completion—31st March 1852.

Colonel A.W. Smart.

Statement showing the Revenue under different heads in the Nellore district for a series of years from 1850-51.

Years.	I. Land Revenue.			IV. Stamps.			V. Excise.	VII. Customs.			VIII. Assessed Taxes.	X. Registration.	XI. Tributes.
	Rs.	*a.*	*p.*	*Rs.*	*a.*	*p.*	*Rs.*	*Rs.*	*a.*	*p.*	*Rs.*	*Rs.*	*Rs.*
1850-51	18,18,008	0	5	13,785	4	0	...	10	2	5	...	...	...
1851-52	18,79,366	12	2	16,124	4	0	...	184	9	2	...	...	...
1852-53	18,03,424	7	2	16,670	4	0	...	172	4	0	...	...	...
1853-54	12,19,664	2	9	18,287	12	0	...	24	1	3	...	...	...
1854-55	15,15,969	1	6	19,446	4	0	...	112	13	9	...	...	...
1855-56	15,43,487	9	11	19,919	8	0	...	...			...	...	...
1856-57	16,64,482	0	9	21,803	12	0	...	16	11	8	...	...	...
1857-58 . . .	13,36,906	10	3	21,983	4	0	...	16	5	11	...	...	...
1858-59	17,02,708	15	8	22,502	0	0	...	680	3	11	...	...	...
1859-60	18,52,243	11	7	25,457	7	7	...	234	8	3	...	...	...
1860-61	16,06,091	12	9	41,710	11	8	...	110	4	5	...	...	...
1861-62	21,53,985	0	0	84,262	0	0	...	466	0	0	1,070	..	...
1862-63	22,33,436	0	0	44,588	0	0	...	779	0	0	65,740	...	...
1863-64	23,05,079	0	0	55,384	0	0	...	284	0	0	42,571	...	...
1864-65	24,60,663	0	0	58,162	0	0	...	79	0	0	41,247	...	...
1865-66	24,73,132	0	0	65,093	0	0	...	52	0	0	9,968	...	...
1866-67	24,51,344	0	0	73,756	0	0	...	131	0	0	21,836	...	...
1867-68	23,25,569	0	0	97,314	0	0	...	233	0	0	16,643	...	...
1868-69	21,34,227	0	0	1,24,873	0	0	...	468	0	0	39,236	...	...
1869-70	21,67,562	0	0	1,05,612	0	0	...	25	0	0	70,024	...	...
1870-71	24,08,295	0	0	1,02,402	0	0	...	4	0	0	1,07,682	...	...
1871-72	...			...			...	...			...	...	...
1872-73	...			...			...	...			...	...	...
1873-74	...			...			...	...			...	...	...
1874-75	...			...			...	...			...	...	...
1875-76	...			...			...	...			...	...	...
1876-77	13,84,960	0	0	1,21,206	0	0	70,613	414	0	0	...	...	...
1877-78	8,47,040	0	0	1,36,344	0	0	55,548	487	0	0	...	...	...
1878-79	30,02,053	0	0	1,61,357	0	0	80,003	907	0	0	31,175	...	...
1879-80 . .	26,21,878	0	0	1,69,573	0	0	1,17,610	204	0	0	29,800	...	...
1880-81	24,67,837	0	0	1,46,530	0	0	95,933	71	0	0	16,844	5,994	...
1881-82	26,59,282	0	0	1,58 905	0	0	1,02,700	6	0	0	17,640	11,197	...
1882-83	30,59,223	0	0	1,47,253	0	0	1,97,407	17	0	0	17,749	10,052	...
1883-84	25,05,858	0	0	1,51,358	0	0	1,29,457	7	0	0	17,773	10,672	...
1884-85	19,46,006	0	0	1,67,802	0	0	1,71,486	65	0	0	17,075	12,502	...
1885-86	24 79,433	0	0	1,78,922	0	0	2,03 948	70	0	0	16,666	14,867	...
1886-87	25,33,502	0	0	1,72,549	0	0	1,84,431	50	0	0	48 156	15,109	...
1887-88	25,02,918	0	0	1 74,266	0	0	2,58,391	98	0	0	50,475	15,013	...
1888-89	34,93,628	0	0	1,88,990	0	0	2,22,133	79	0	0	42,329	17,782	...
1889-90	23,03,856	0	0	1,91,185	0	0	2,28,867	52	0	0	42,109	20,357	...
1890-91	28,02,061	0	0	2,21,771	0	0	2,16,494	7	0	0	44,724	20,311	. .
1891-92	21,79,437	0	0	2,03,255	0	0	1,79,199	360	0	0	48,828	24,152	...
1892-93	25,97,873	0	0	2,12,189	0	0	1,57,419	18	0	0	46,970	40,339	...
1893-94	28,51,088	0	0	2,20,337	0	0	2,07,819	...			58,371	23,942	...
1894-95	21 87,377	0	0	2,25,833	0	0	2,75,427	28	0	0	73,501	23,150	...
1895-96	26,60,142	0	0	2,29,403	0	0	2,54,236	22	0	0	80,100	23,468	...
1896-97 . . .	25,44,164	0	0	2 27,863	0	0	2,56,647	65	0	0	96,196	24,943	...
1897-98	23,27,060	0	0	2,49,284	0	0	2,90,572	16	0	0	84,830	24,382	...
1898-99	24 57,535	0	0	2,49,473	0	0	2,81,829	...			98,024	29,857	...
1899-1900	25,77,140	0	0	2,49 866	0	0	2 84,193	..			93,961	26,232	...
1900-1901	23,81,099	0	0	2,62,403	0	0	2,41,640	...			1,06,269	30,939	...

		Date of commencement.	Date of completion.
I.	Penner Anicut Works	Early in 1853.	March 1862.
II.	Sangam „ „	February 1882.	September 1886.

Statement showing the collections under different heads of Revenue in the Ganjam district from 1870-71 to 1879-80.

Years.	Land Revenue.	Abkari.	Assessed Taxes.	Sea Customs.	Land Customs.	Salt.	Stamps.	Forest Revenue	Total.
1	2	3	4	5	6	7	8	9	10
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1870-71 . .	11,15,364	83,521	46,115	31,236	...	14,95,968	81,764	...	28,53,968
1871-72 . .	8,72,807	73,894	13,114	48,863	...	14,31,118	78,259	...	25,18,055
1872-73 .	12,56,877	75,427	12,042	87,463	...	15,46,113	80,557	...	30,58,479
1873-74 . .	11,68,841	77,718	27	1,56,799	...	15,47,652	85,832	...	30,36,869
1874-75 . .	13,17,685	84,553	...	1,13,733	...	16,90,497	94,186	...	33,01,454
1875-76 . .	11,73,482	88,975	50	67,206	...	19,63 960	93,385	...	33,87,058
1876-77 . .	11,99,086	89,037	1,042	6,812	13	23,67,515	1,08,122	...	37,71,627
1877-78 . .	10,77,996	94,643	...	2,979	...	20,46,731	1,26.903	...	23,50,347
1878-79 . .	12,82,749	74,153	36,809	9,780	...	...	1,27,663	...	15,31,154
1879-80 . .	12,87,108	91,620	25,602	61,728	...	...	1,21,231	...	15,87,289

Information for the years 1850 51 to 1869-70 not available.

Colonel A. W. Smart.

Statement showing the Revenue under different heads in the Ganjam district from the years 1880-81.

Year.	I. Land Revenue.			XI Tributes.	V. Excise.			VIII. Assessed Taxes.			VII. Customs.			IV. Stamps.			X. Registration.		
	Rs.	*a.*	*p.*		*Rs.*	*a.*	*p.*	*Rs.*	*a.*	*p.*	*Rs.*	*a.*	*p.*	*Rs.*	*a.*	*p.*	*Rs.*	*a.*	*p.*
1880-81	12,64,864	11	11	...	1,22,898	3	2	12,133	1	3	1,53,179	5	10	1,23,098	4	0	2,848	14	8
1881-82 .	11,81,591	2	10	...	1,20,771	15	11	9,918	5	9	1,32,704	13	5	1,29,261	3	1	7,531	2	7
1882-83 .	12,68,906	9	3	...	1,18,282	8	11	9,766	7	0	72,181	11	0	1,29,581	7	1	7,198	3	7
1883-84 .	12,07,965	0	1	...	1,13,512	10	5	9,811	15	11	90,228	3	11	1,42,929	2	0	8,501	13	4
1884-85	12,74,401	13	4	..	1,36,828	8	6	7,772	13	0	57,829	2	8	1,59,971	2	0	11,006	2	4
1885-86 .	11,39,722	11	3	...	1,37,770	6	7	7,445	10	9	3,052	15	2	1,48,987	13	6	12,056	3	11
1886-87 .	13,65,394	13	4	...	1,33,624	14	11	23,635	15	2	8,286	9	5	1,50,859	13	3	12,762	11	10
1887-88 .	11,83,630	8	0	...	1,33,522	3	0	25,045	8	9	17,574	1	7	1,58,745	6	0	15.798	9	10
1888-89 .	8,58,423	14	8	...	1,30,818	7	8	24,471	2	1	6,731	4	11	1,52,202	11	6	16,020	11	3
1889-90 .	12,18 725	15	7	...	1,33,577	5	7	24,474	15	0	1,997	8	4	1,69,020	13	0	16,727	0	11
1890-91 .	14,16,181	9	7	...	1.60,450	3	4	24,125	4	8	7,780	2	7	1,65,112	12	0	17,731	15	2
1891-92 .	11,41,046	1	8	...	2,12,577	5	8	26,066	0	[illegible]	4,653	9	3	1,73,767	10	0	19 971	2	0
1892-93 .	14,00,036	8	5	...	2,15,708	7	4	32,065	4	9	4,736	0	1	1,83,507	3	11	21,327	7	4
1893-94 .	13,49,506	10	5	...	2.67,362	15	1	40,801	14	10	48,570	7	7	1,89,347	9	0	21,455	4	0
1894-95 .	14,26,882	10	5	...	2,56,329	7	11	43,163	6	10	31,588	4	11	1,93,462	9	0	21,860	2	6
1895-96 .	13,31,331	6	2	...	3,43,256	15	0	42,270	10	4	6,346	9	2	2,01,403	5	0	20,201	0	9
1896-97 .	9,81,251	4	1	...	4,09,847	2	2	40,553	6	4	30,066	1	5	2,02,781	3	10	24,884	12	0
1897-98 .	11,78 191	9	1	...	3,05,084	15	6	51,603	11	7	9,143	3	10	2,15,867	3	3	55,570	2	1
1898-99 .	16,09,294	8	4	...	3,02,613	6	5	63,776	10	4	34,134	3	1	2,16,837	13	9	26,688	14	1
1899-1900	14,19,761	13	11	...	2,70,453	4	2	69,487	4	11	19,115	9	11	2,11,021	3	9	25,276	1	10
1900-1901	14,38,929	7	9	...	3,24,691	4	1	75,032	4	4	2,065	10	3	2,21,718	6	9	25,755	0	6

Note.—Rushikulya project; commenced in 1884-85; completed in March 1901.

8. I now proceed to answer *seriatim* the questions set by the Commission for Public Works Department officers.

QUESTION No. 1.—*Statement showing the cultivable and occupied area and area irrigated under Government irrigation works, tank works maintained by Government for which no revenue accounts are kept, private canals or storage works, wells and other sources.*

Number.	District.	Total area of the district exclusive of zamindaris and those under the Court of Wards and private European management.	Population.	Cultivable area.	Occupied area.	Irrigated area	Proportion of irrigated area to cultivable area.	Proportion of irrigated area to occupied area.	Proportion of irrigated area to the total area of the district.	Area irrigated per head of the population.
1	Ganjam . Ganjam Agency	3,111,135	755,225 *321,144	592,659	517,052	235,011	39·65	45·45	7·52	0·21
2	Vizagapatam Vizagapatam Agency.	1,150,533	661,570 *850,988	354,325	330,818	92,924	26·23	28·09	8·07	0·06
3	Godavari . Godavari Agency	3,101,336	1,407,007 *62,608	1,726,248	1,512,321	593,547	34·38	39·12	19·13	0·40
4	Kistna . .	4.253,482	1,777,096	3,050,517	2,660.523	447,464	14·66	16·82	10·51	0·25
5	Nellore .	3,234.560	1,006,850	1,960,556	1,600,853	333,813	17·03	20·85	10·32	0·33
6	Bellary . .	3,748,663	947,214	2,802,518	2,389,148	62,957	2·24	2·63	1·67	0·06
7	Cuddapah . .	5,582,760	1,290,939	2,449,333	1,974,863	293,636	11·99	14·87	5·25	0·22
8	Kurnool . .	4,808,960	872,055	2.443,869	2,112,705	89,174	3·62	4·22	1·08	0·10
9	Anantapur	3,557,047	788,254	2,660,178	1,815,231	139,260	5·23	7·67	3·91	0 18
10	North Arcot .	2,694,031	1.512,113	1,362,046	1,031,193	430,737	31·55	41·77	15·98	0·28
11	Salem . .	3,786,395	1,560,957	1,795,897	1,440,229	189,420	10·19	13·08	4·12	0·12
12	Coimbatore .	4,923,540	2,147,280	2,998,616	2,787,888	400,431	13·35	14·73	8·13	0·18
13	Chingleput . .	1,589,885	1,095 800	952,889	862,539	452,587	47·50	52·74	28·46	0·41
14	South Arcot .	3,173,408	2,304,165	2,034,158	1,673,475	478,431	23·52	28·59	15·07	0·20
15	Tanjore . .	2,194,255	2,147,346	1,671,056	1,544,192	889,303	53·22	57·59	40·52	0·41
16	Madura . .	2,262,910	1,662,103	1,443,431	1,216,962	292,990	23·00	24·07	12·94	0·17
17	Trichinopoly .	1,987,188	1,238,845	4,251,701	3,866,468	205,522	4·83	5·32	10·03	0·16
18	Tinnevelly .	2,546,635	1,592,467	1,761,138	1,706,369	295,621	16·78	17·32	11·60	0 18

* The figures for the agency tracts include the population of Government and zamindari lands, as figures for these are not available separately.

Diagram in Appendix A is also a graphic answer to question No. 1.

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QUESTION No. 2.—*Statement showing the areas at present irrigated in ordinary and famine years by existing Major works, development of irrigation on them during last 15 years, and further development anticipated, etc.*

—	ACTUAL AREA IRRIGATED. Ordinary year (1900-1901). First crop.	Ordinary year (1900-1901). Second crop.	Famine year. Year.	Famine year. First crop.	Famine year. Second crop.	DEVELOPMENT OF IRRIGATION DURING THE LAST 15 YEARS. 1886-87. First crop.	1886-87. Second crop.	1900-1901. First crop.	1900-1901. Second crop.	Development. First crop.	Development. Second crop.
1	2	3	4	5	6	7	8	9	10	11	12
	Acres.	Acres.		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Godavari delta system	674,319	136,527	1891-92	637,783	91,069	578,663	84,650	674,319	136,527	95,651	101,877
Kistna " "	590,752	218	"	478,167	897	842,108	88	590,752	218	248,644	120
Penner river canals	138,997	12,340	"	107,080	676	104,245	1,973	138,997	12,430	34,752	10,477
Kurnool-Cuddapah Canal*	48,926	12,530	1896-97	77,896	8,060	22,026	650	48,926	12,530	26,900	11,886
Barur tank project	2,841	997	1891-92	1,687	549	(a) 462	1	2,841	997	2,379	996
Cauvery delta system	851,775	93,479	1899-1900	738,094	89,639	856,914	96,843	851,775	93,479	...	...
Srivaikuntam anicut system	21,054	20,691	1892-93	16,426	11,422	20,069	17,587	21,054	20,691	985	3,104
Periyar project	100,158	31,455	...	..	...	(b) 48,623	11,950	100,158	31,455	51,535	19,505
Rushikulya project	80,204	2,164	1899-1900	78,445	3,181	(c) 3,508	675	80,204	2,164	76,696	1,489

—	Further development anticipated.† First crop.	Further development anticipated.† Second crop.	Duty, i e., number of acres irrigated per cubic foot per second. First crop.	Duty. Second crop.	Improvement of duty. First crop.	Improvement of duty. Second crop.	Proportion of second to first crop.	Capital cost of the works per cubic foot per second of maximum supply or million cubic feet stored.	Average for ten years. Gross revenue per acre irrigated.	Average for ten years. Working expenses per acre irrigated.	Net revenue realised up to date after deducting interest charges.
	13	14	15	16	17	18	19	20	21	22	23
	Acres.	Acres.					Per cent.				
Godavari delta system	250,000	...	118	28	...	...	16·83	2,462	3·68	0·95	40,584,600
Kistna " "	650,000	...	105	...	...	...	0·06	3,588	4·40	1·27	23,420,593
Penner river canals	266,383	...	113	34	...	...	5·83	7,036	4 01	0 92	795,378
Kurnool-Cuddaph Canal*	46,500	...	45	14	...	...	17·17	27,784	3·02	2 80	...
Barur tank project	2,955	...	60		...	...	44 30	295	2·55	1·15	..
Cauvery delta system	440,000	...	41	157	...	...	11·41	163	4·01	0·48	24,973,437
Srivaikuntam anicut system	6,744	...	63	36	...	...	71·01	(e) 169	4 58	1·13	157,148
Periyar project	20,000	...	178		...	...	31·40	(d)	4·28	1·07	...
Rushikulya project	40,000	60,000	...	...	...	...	2·69	(d)	1·78	1·05	...

* Cultivable area commanded 300,000 acres.

† Details are given below.

(a) This project was brought into operation in 1887-88.

(b) " " in 1896-97.

(c) " " in 1892-93.

(d) The projects not having fully developed, these figures have not been filled in.

(e) Per million cubic feet stored.

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Further development anticipated in the near future.

	Acres.	Acres.
Godavari delta system—		
In delta (see Mr. Marshall's answers)	100,000	
By pumping	150,000	
TOTAL		250,000
Kistna delta system—		
Present ultimate area	700,000	
Area irrigated in 1900-1901 (first crop)	590,000	
Development anticipated when duty of water is improved	110,000	
By still further improvement in distributaries another 90,000 acres may be expected without reservoir	90,000	
With reservoir	400,000	
By pumping (Divi)	50,000	
TOTAL, KISTNA DELTA		650,000

Kistna reservoir.—It is impossible to say at present what may be the areas irrigated in the upland taluks of the district from a reservoir. A separate note on the subject will be presented to the Commission by Mr. Reid.

	Acres.	Acres.
Penner river canals system—		
Ultimate area	165,385	
Area irrigated in 1900-1901 (first crop)	138,997	
		26,388
Development anticipated	40,000	
If Tungabhadra water brought into Penner and stored	200,000	
		240,000
TOTAL		266,388
* Kurnool-Cuddapah Canal—		
Present ultimate area (wet)	80,000	
Largest area irrigated during the last 10 years (first crop)	77,896	
Development anticipated, say		2,000
Chapad project	5,000	
Maidkur project	6,000	
Ukkavapalli project	600	
Velgode project	2,900	
		14,500
If discharge of canal increased to 2,000 cusecs, another		30,000
TOTAL		46,500

Kurnool-Cuddapah Canal.—It is advisable that this canal and its distributaries should be developed at an early date. For this it will be necessary to increase the discharging capacity of the canal to, say, 2,500 cusecs passing 2,000 cusecs at the Mitakondah cutting, where only 800 cusecs can now pass. Even if the whole of the 2,000 cusecs is not utilised in Cuddapah it will be of great value in Nellore by discharge over the Adyampalli anicut.

	Acres.	Acres.
Barur tank project—		
Irrigable area	5,796	
Area irrigated in 1900-01 (first crop)	2,841	
Difference		2,955
(It would be well to ascertain if dry crop could be irrigated under this tank.)		

	Acres.	Acres.
Cauvery delta system—		
Irrigable area (below Cauvery-Vennar Regulators) acres, 868,342.		
Largest area yet irrigated, 1891-1892, acres, 862,178		
With improved distribution another 50,000 could be irrigated	50 000	
With storage on Cauvery as proposed	300,000	
With storage on Bhavani (in Coimbatore)	90,000	
TOTAL		440,000
Srivaikuntam anicut system—		
Present ultimate area	27,798	
Area irrigated in 1900-01 (first crop)	21,054	
Development anticipated		6,744

	Acres.	Acres.
Periyar project—		
Ultimate area	99,761	
Area irrigated in 1900-01 (first crop)	100,158	
The ultimate area is under revision.		
The Executive Engineer, Madura Division, states that by constructing a storage reservoir at the foot of the hills at a cost of about 10 lakhs of rupees, it will be possible to irrigate an additional area of at least		20,000

It is possible the same result may be arrived at by enlargement of tunnel. The whole question requires investigation.

	Acres.	Acres.
Rushikulya project—		
The project has not yet fully developed.		
Ultimate area	120,000	
Area irrigated in 1900-01 (first crop)	80,204	
Further development anticipated, say		40,000

(Second crop anticipated 60,000.)
Another storage reservoir is
much wanted.

Duty.—The improvement of duty is one that requires much more study than it has yet received in Madras. There is no question that in many areas a great deal more water is used for rice than is necessary. The effects of supersaturation have not been sufficiently observed, and experiment as to the minimum quantities of water required to give the best outturn should be made the subject of experiment on Government model farms.

Penner river canals system.—Duty at present is 60 acres; may by careful management rise to 75 acres (*vide* answers by Mr. R. A. Srinivasa Aiyangar).

Kistna delta system.—Duty at present 60 acres; may rise to 90 acres or higher, provided all channels are properly designed and spouted and no unnecessary high lands are irrigated (*vide* answers by Mr. Lacey).

The Executive Engineer on special duty, Kistna, states that the average duty of the whole system may perhaps be improved by degrees to 80; but it seems at present unlikely that it can be taken much higher. Individual canals may have a slightly better duty, but not in any case exceeding 90 (*vide* answers by Mr. Howley).

The greatest demand takes place in July and August at time of transplantation. If areas are blocked out and supplied by rotation, the duty could be very much improved.

Periyar project.—Any statement as regards the duty must be discounted by the fact that we are not at present in a position to state definitely what we owe to the rainfall in the irrigated area itself and in the catchment basin of the tanks within the irrigated area. Also until the season 1899-1900, little or no regulation at Thekkady was possible.

For 1900-01 the duty works out to 7·337 acres per million cubic feet stored. If rainfall is taken into account, the duty will become 5·5 acres per million cubic feet which is a low figure (*vide* answers by Mr. Keeling).

Extension of second-crop cultivation. Penner river canals.—Second-crop cultivation may extend (*vide* answers by Mr. R. A. Srinivasa Aiyangar). Extent not given.

Kistna delta system.—No second wet-crop cultivation in the delta. It is better not to encourage the same even if reservoirs were constructed. Watering second dry crop may be encouraged (*vide* answers by Mr. Lacey).

There is practically no second-crop cultivation in the delta owing to the rapid decrease in the discharge of the river towards the end of the calendar year; and without some form of storage work on the river, there does not seem to be any possibility of supplying water for second crop (*vide* answers by Mr. Howley).

Periyar project.—The proportion of first crop to second crop will eventually be 2 to 1 (*vide* answers by Mr. Keeling).

Cauvery delta.—When the drainage improvements are carried out the extent of second-crop cultivation will rise to nearly one-fifth of the area under first crop. The Executive Engineer considers that the question of the supply of manure will effectually bar further extension of second crop (*vide* answers by Mr. S. A. Subramania Aiyar).

Second crop should not be encouraged at the expense of extending single crop in areas commanded and not now irrigated, that is, storage water should not be used for double crop where large areas unirrigated can be still brought under irrigation.

In Tanjore, distribution has been much neglected. The distribution of minor rivers should be gradually remodelled by the construction of regulators, to keep up the level of water and by the reduction of the number of heads in the various reaches.

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* Cultivable area commanded (said to be) 800,000 acres.

QUESTION 3.—*Statement showing the surplus discharges of the* **Godavari River** DOWLAISHWERAM ANICUT *in millions of cubic feet.*

Colonel A. W. Smart.

YEAR.	SOUTH-WEST MONSOON.					NORTH-EAST MONSOON.			
	June.	July.	August.	September.	Total.	October.	November.	December.	Total.
1	2	3	4	5	6	7	8	9	10
1877 .	62,449	299,496	452,928	345,405	1,160,278	118,742	55,248	7,800	181,790
1878 .	...	676,310	1,935,095	1,043,376	3,654,781	510,332	138,252	49,117	697,701
1879 .	228,415	502,717	1,700,584	1,118,604	3,550,320	578,251	86,164	13,224	677,639
1880 .	34,528	869,296	724,960	852,190	2,480,974	363,978	61,876	40,554	466,408
1881 .	97,267	833,820	1,057,349	781,317	2,769,753	432,878	39,348	7,599	479,825
1882 .	133,983	1,238,180	770,553	1,114,316	3,252,032	268,218	19,860	16,296	304,374
1883 .	130,683	1,256,572	1,387,505	1,739,973	4,514,733	769,145	143,796	16,464	929,405
1884 .	14,650	1,142,198	1,473,943	1,745,218	4,376,039	629,025	11,586	10,920	651,531
1885 .	918,180	1,017,264	1,128,538	673,121	3,737,103	400,069	43,654	28,953	472,676
1886 .	165,027	1,375,489	1,189,662	704,813	3,434,991	435,123	144 505	62,577	642,205
1887 .	169,832	1,632,587	1,700,074	1,139,039	4 641,532	283,913	106,219	20,954	411,086
1888 .	12,387	816,937	922,865	528,651	2,280,840	71,872	34,290	9,007	115,169
1889 .	27,470	633,795	1,637,252	1,168,214	3,466,731	715,267	107,123	10,242	832,632
1890 .	179,585	1,206,903	1,625,540	1,046,678	4,058,711	436,283	60,108	2,753	499,144
1891 .	...	437,499	1,022,308	1,527,640	2,987,447	908,986	...	...	908,986
1892 .	76,297	564,197	1,133,426	1,770,133	3,544,053	387,800	185,168	5,368	578,336
1893 .	327,824	488,072	1,404,497	1,949,705	4,170,098	773,784	269,000	26,912	1,069,696
1894 .	73,721	916,180	968,493	1,452,542	3,410,936	482,618	225,592	...	708,210
1895 .	205,711	580,599	1,607,980	871,557	3,265,847	277,303	40,394	...	317,697
1896 .	133,365	589,031	2,001,884	490,295	3,214,575	25,600	...	...	25,600
1897 .	15,202	208,229	1,196,002	1,202,418	2,621,851	566,059	91,835	3,154	661,048
1898 .	120,023	879,102	863,361	665,304	2,527,790	138,696	30,883	5,959	175,538
1899 .	19,573	15,543	123,856	179,458	338,430	2,034	...	...	2,034
1900 .	16,183	468,194	1,240,130	1,197,478	2,921,985	338,186	27,242	6,396	371,824

Statement showing the surplus discharges of the **Kistna River** *at* BEZWADA ANICUT *in millions of cubic feet.*

YEAR.	SOUTH-WEST MONSOON.					NORTH-EAST MONSOON.			
	June.	July.	August.	September	Total.	October.	November.	December.	Total.
1	2	3	4	5	6	7	8	9	10
1877 .	38,752	70,858	84,786	95,124	289,520	101,663	43,908	23,918	169,189
1878 .	1,718	31,671	168,230	104,090	305,709	122,312	35,269	20,361	177,942
1879 .	23,160	98,865	133,698	76,158	331,881	43,222	24,500	16,433	81,155
1880 .	47,371	567,778	373,010	375,765	1,363,924	278,259	222,557	147,601	648,417
1881 .	26,228	449,787	621,981	279,879	1,377,875	396,524	23,499	8,255	428,278
1882 .	513,343	1,063,341	601,274	640,367	2,818,325	383,057	226,533	76,918	686,508
1883 .	177,941	886,980	544,428	703,072	2,312,421	54,859	138,457	20,951	214,267
1884 .	2,722	498,043	781,900	632,715	1,915,380	412,915	181,437	69,403	663,755
1885 .	38,282	53,659	826,769	566,202	1,484,912	689,985	194,434	222,157	1,106,576
1886 .	240,756	737,394	776,514	431,818	2,186,482	642,050	251,237	149,098	1,042,385
1887 .	272,771	1,522,965	781,922	778,762	3,356,420	401,637	212,065	63,537	677,239
1888 .	112,062	1,619,440	1,102,577	48,388	2,882,467	292,900	74,708	36,250	403,858
1889 .	135,656	940,019	925,237	1,037,148	3,038,060	1,184,219	127,053	66,835	1,378,107
1890 .	108,901	1,317,085	1,491,193	394,390	3,311,569	217,773	118,034	20,896	356,703
1891 .	23,458	497,454	1,251,962	404,946	2,177,820	295,087	15,166	...	310,253
1892 .	260,659	1,153,057	997,190	1,660,181	4,071,087	747,185	643,985	42,101	1,433,574
1893 .	667,048	717,104	1,087,095	833,699	3,314,946	737,318	124,146	21,748	883,212
1894 .	160,310	1,388,849	697,008	504,800	2,750,967	262,518	167,254	22,760	452,532
1895 .	10,153	507,568	827,071	775,439	2,120,231	416,014	109,188	18,090	543,292
1896 .	203,202	644,676	1,291,895	120,651	2,260,414	43,181	16,008	21,423	80,612
1897 .	161,235	462,838	890,833	488,659	2,003,565	439,643	28,051	...	467,694
1898 .	175,909	541,259	567,697	438,213	1,723,078	333,480	69,465	11,772	414 717
1899 .	89,370	245,679	102,553	292,722	730,324	16,622	117	...	16,739
1900 .	64,898	733,070	1,020,406	222,702	2,041,076	140,568	5,407	...	145,975

Colonel
J. W. Smart.

Statement showing the surplus discharges of the **Tungabhadra River** *at* SUNKESALA ANICUT *in millions of cubic feet.*

YEAR.	SOUTH-WEST MONSOON.					NORTH-EAST MONSOON.			
	June.	July.	August.	September.	Total.	October.	November.	December.	Total.
1	2	3	4	5	6	7	8	9	10
1880 .	...	128,643	72,970	39,873	241,486	66,025	45,368	14,134	125,527
1881 .	7,680	42,153	91,882	36,148	177,863	33,439	14,997	2,070	50,506
1882 .	63,354	237,234	33,046	10,920	344,554	7,039	5,365	...	12,404
1883 .	9,736	167,890	121,524	211,769	510,919	88,384	41,694	157,645	290,723
1884 .	...	55,737	135,736	88,683	280.156	47,871	12,811	2,253	62,965
1885 .	28,548	125,952	162,180	69,525	386,205	73,875	482	...	74,357
1886 .	72,789	136,398	123,480	83,855	416,522	87,983	37,440	4,654	130,077
1887 .	59,687	178,439	87,873	91,987	417,986	67,217	49,367	15,046	131,630
1888 .	27,426	200.294	161,925	56,695	446,340	28,756	61,922	7,330	101,008
1889 .	43,064	133,863	136,427	215,066	528,420	156,587	17,620	8,713	182,920
1890 .	17,008	115,038	115,091	28,860	275,997	33.079	70,520	8,712	112,311
1891 .	12,081	90,853	97,217	35,082	235,236	40.042	11,205	810	52,057
1892 .	31,741	173,864	139,119	123,879	468,606	52,671	15,099	7,269	75,039
1893 .	39,837	72,539	82,661	56,078	251,115	74,631	15,552	4,313	94,496
1894 .	17,189	63,155	89.263	29,352	199 209	26,726	14,725	1,181	42,632
1895 .	31,641	77,323	105,914	39,413	254,294	50,271	17,994	3 615	71,880
1896 .	46.376	195,726	326,676	49,147	617,925	39,213	30,354	12,015	81,612
1897 .	88,339	98,993	217,980	169,237	574,549	104,738	22,560	10,198	137,496
1898 .	46,445	111,480	148.745	120,930	430,595	136,652	66,707	24,186	227,545
1899 .	44.123	98,421	48,776	110,007	301,327	34,265	8,661	...	42,926
1900 .	27,661	285,394	272,896	99,084	685,035	58,451	19,896	12,093	90,440

Note.—The Tungabhadra surplus has been dealt with in a separate note—*vide* Appendix B.

Statement showing the surplus discharges of the **Penner River** *at* NELLORE ANICUT *in millions of cubic feet.*

YEAR.	SOUTH-WEST MONSOON.					NORTH-EAST MONSOON.			
	June.	July.	August.	September	Total.	October.	November.	December.	Total.
1	2	3	4	5	6	7	8	9	10
1877 .	7,416	...	...	31,650	39,066	50,808	42,708	562	94,078
1878 .	5 602	29,088	40,496	60,945	136,131	101,616	38,461	7,221	147,298
1879 .	15,629	6,667	43,318	26,489	92,103	13,171	30,474	...	43,645
1880 .	1,798	...	16,271	24,161	42,230	18,610	51,896	34,663	105,169
1881 .	596	...	11,055	19 297	33,948	20,882	22,933	1,671	45,486
1882 .	90	637	3,151	20,965	24,852	23,266	42,361	50,532	116,159
1883 .	3,841	2,242	25.020	2,513	33,616	53,820	67,231	25,779	146,830
1884 .	...	...	789	1,370	2,159	35,725	83,873	42,704	162,302
1885 .	1,389	6,089	16,324	14,614	38,416	30,749	33,994	32,619	97,362
1886 .	...	...	27,730	...	27,730	47,266	30,611	1,525	79,402
1887 .	...	6,802	16,924	57,441	81 167	36,080	66,309	39,489	141,884
1888 .	...	...	...	...	...	6,015	45,564	7,380	58,959
1889 .	...	8,886	12,521	54,758	76,165	101,473	14,770	3,811	120,054
1890 .	...	..	6,419	14,402	20,821	21,458	20,417	381	42,256
1891 .	...	..	1,229	...	1,229	3,002	...	...	3,002
1892 .	7,594	30,790	36,855	76,912	152,151	77,165	31,106	667	108,938
1893 .	...	11,455	1,823	4,863	18,141	39,293	79,048	4,192	122,533
1894 .	...	6,104	25 487	33,293	64,884	29,843	61,776	...	91,619
1895 .	...	...	...	27,730	27,730	57,441	17,006	...	74,447
1896 .	...	...	3,782	953	4,735	...	8,598	1,216	9,814
1897 .	608	2,123	9,706	41,352	53,789	22,179	...	...	22,179
1898 .	572	...	191	30,552	31,315	12,061	37,853	16,471	66,385
1899 .	...	...	...	21,055	21,055	2,968	7,478	...	10,446
1900 .	48	9,671	429	38,895	49,043	11,782	...	143	11,925

Colonel A. W. Smart.

Statement showing the surplus discharges of the **Palar River** *at* PALAR ANICUT *in millions of cubic feet.*

YEAR.	SOUTH-WEST MONSOON.					NORTH-EAST MONSOON.			
	June.	July.	August.	September	Total.	October.	November.	December.	Total.
1	2	3	4	5	6	7	8	9	10
1879	...	...	...	...	...	...	...	...	...
1880	...	...	...	...	...	...	457	267	724
1881	...	...	256	622	878	9,787	2,859	...	12,646
1882	...	...	65	...	65	...	17,902	21,657	39,559
1883	...	...	...	...	...	3,861	24,612	9,039	37,512
1884	...	...	...	...	...	5,030	7,846	30,341	41,217
1885	...	...	...	...	...	...	1,786	754	2,540
1886	698	790	1,991	1,773	5,252	653	1,933	...	2,586
1887	...	...	...	...	...	324	5,545	10,560	16,429
1888	...	...	244	326	570	721	24,371	131	25,223
1889	89	...	989	1,724	2,802	27,430	...	...	27,430
1890	...	4	17	517	538	115	3,607	...	3,722
1891	...	...	...	...	...	1,738	...	...	1,738
1892	...	237	1,207	1,318	2,762	482	...	...	482
1893	...	...	...	...	...	...	6,056	...	6,056
1894	...	...	...	...	...	...	...	...	...
1895	...	...	...	...	...	...	...	257	257
1896	...	...	...	...	...	...	...	...	...
1897	...	...	...	3,482	3,482	6,052	...	...	6,052
1898	...	...	...	94	94	...	19,967	11,533	31,500
1899	...	...	...	...	...	...	...	...	..
1900	...	...	...	...	...	...	...	...	...

Statement showing the surplus discharges of the **Ponniar River** *at* TIRUKKOYILUR ANICUT *in millions of cubic feet.*

YEAR.	SOUTH-WEST MONSOON.					NORTH-EAST MONSOON.			
	June.	July.	August.	September.	Total.	October.	November.	December	Total.
1	2	3	4	5	6	7	8	9	10
1884	145	8	651	78	882	9,094	16,519	30,932	56,545
1885	...	...	...	453	453	12,499	1,657	2,484	16,640
1886	2,026	1,829	3,203	5,018	12,076	1,360	5,798	459	7,617
1887	1,023	529	2,120	1 532	5,204	17,653	19,152	8,531	45 336
1888	...	...	386	1,979	2,365	3,684	22,408	6,594	32,686
1889	...	661	1,081	7,861	9,603	11,533	293	212	12,038
1890	258	196	1,694	2,999	5,147	2,212	6,701	...	8,913
1891	...	...	...	...	...	3,584	1,754	216	5,584
1892	194	2,006	3,852	511	6,563	999	...	...	999
1893	931	1,382	414	...	2,727	2,478	10,421	400	13,299
1894	...	766	3,526	2,855	7,147	4,484	4,568	55	9,107
1895	156	...	407	8,216	8,779	14,621	8,453	1,307	24,381
1896	19	...	...	3,311	3,330	1,217	1,872	4,762	7,851
1897	138	...	3,026	16,539	19,703	16,957	109	13	17,079
1898	...	...	...	214	214	4,585	38,779	13,382	56,746
1899	...	...	...	5,791	5,791	1,111	...	...	1,111
1900	...	1,323	78	3,385	4,786	2,119	28	...	2,147

Note.—Figures not available for years prior to 1884.

Colonel A. W. Smart.

Statement showing the surplus discharges of the **Vellar River** *at* SHATIATOPE ANICUT *in millions of cubic feet.*

YEAR.	SOUTH-WEST MONSOON.					NORTH-EAST MONSOON.			
	June.	July.	August.	September.	Total.	October.	November	December.	Total.
1	2	3	4	5	6	7	8	9	10
1879	157	10,783	540	3,021	14,501	2,752	868	...	3,620
1880	...	...	2,573	1,036	3,609	8,697	32,024	13.807	54,528
1881	...	...	506	2.221	2.727	2,461	2.721	1,073	6,255
1882	117	338	5,592	2,868	8,915	1,258	11,916	2,149	15,323
1883	*	57	2,328	629	3,014	7,930	16,211	2,472	26,613
1884	290	...	...	45	335	725	33,494	33,866	68,025
1885	830	181	107	2.258	3,376	...	...	...	...
1886	*	*	*	*	..	.	...	...	...
1887	506	293	1,502	746	3,047	1.216	22,437	13,974	37,627
1888	481	105	1.577	2,675	4,838	4,329	9,780	9,403	23,512
1889	...	8,095	1,389	2,848	12,332	4,968	...	788	5,756
1890	799	42	1,553	929	3,323	2,956	8,969	...	11,925
1891	109	...	...	579	688	6,889	2,464	1,089	10,442
1892	...	710	2,329	12	3,051	1,906	...	...	1,906
1893	786	195	964	817	2,762	7.263	29,263	8,736	45,262
1894	.	...	1,248	851	2,099	312	2.976	619	3.937
1895	243	...	3,108	14,826	18,177	26.819	14,344	14,789	55,952
1896	128	5	94	5,718	5,945	3,035	6,706	11,516	21,257
1897	20	...	163	8,084	8,267	9,338	1,206	3	10,547
1898	...	42	278	510	830	4,113	33,988	976	39,077
1899	...	58	...	786	844	1,903	185	596.	2,684
1900	251	921	260	3,077	4,509	948	884	1,447.	3,279

* Discharge not given in the diagrams.

The three great rivers of this Presidency are the Godavari, Kistna, and Cauvery. The surplus available for storage in all these is very great, especially, so in the Godavari and Kistna.

Godavari.—The possibility of extending irrigation in the delta proper, under the Godavari anicut, is not very great. It is said that another 100,000 acres may be eventually brought under irrigation. It is in the upland taluks, which occasionally suffer from drought, that part of the great surplus available may be utilised. Two pumping schemes on a large scale have been proposed to irrigate 150,000 acres on either side of the river above the anicut works. Other smaller pumping installations will probably also be found possible higher up the river. An investigation of the upper basins of the branches of the river will no doubt bring to light sites for storage reservoirs of which we at present know little or nothing. The area cultivated in the upland taluks was in 1898-99 acres against acres arable. I am not in a position to say anything definite about the Dumagudiem, Upper Godavari works, but trust that some use may be found for them and they need not be abandoned. They cost 70 lakhs.

Kistna.—The surplus available for storage on the Tungabhadra, a branch of the Kistna, has been dealt with in a separate note † Deducting 100,000 millions cubic feet as the surplus that may be utilised by storage on that river, we have still an enormous surplus available in the Kistna below the junction of the Tungabhadra. It is improbable that more than 800,000 acres can be irrigated in the delta proper without storage. To increase the area of irrigation in the delta beyond this figure and to give protective irrigation to the upland taluks, the construction of a large reservoir, most probably on the main river, must be made the subject of investigation. Mr. Reid has been recently occupied on a reconnaissance of the river above the Bezwada anicut and will submit a note amplifying or correcting his previous note printed in Mr. Clerk's report—see page 6. In my opinion if a reservoir is found feasible, and I see no reason against it, the stored water should be utilised in the upper taluks and not in the delta proper (save at the end of the season) to irrigate dry crop It would appear from a demi-official letter received from Mr. Reid that he anticipates that the area commanded will be nearly 1,000,000 acres in the taluks of Setterapalle, Guntur, Narasaraopet, and possibly the lower part of Vinukonda. The amount of silt carried by the river is a great deal more than in the case of the Cauvery and the flood and total yearly discharges are greater, but a reference to the statement of surplus discharge at the Bezwada anicut shows that the reservoir may be left practically empty till September and be filled during that month and October of each year. If this is found feasible, the silt objection will be fully met. The quantity that should be stored will depend on the cultivated area commanded and requiring irrigation; the quantity may be from 40,000 to 60,000 millions cubic feet. The area cultivated in the upland taluks amounts to acres, and the arable area to acres.

Cauvery.—The utilisation of the Cauvery surplus has been dealt with in a separate note, see page 25 of Mr. Clerk's report.

The following is an extract from a further note on the Cauvery-Bhavani discussion just placed before Government:—

"4. The eventual decision to be arrived at is of great import and any wrong decision now will have far-reaching consequences.

"5. The following is a summary of what is claimed for the two reservoirs:—

Bhavani reservoir.—Partial protection to the old irrigation; some increase of double crop, and 90,000 acres new wet cultivation on the border of the delta, principally in Mannargudi taluk where protection against drought is hardly required.

Cauvery reservoir.—Full protection to the old irrigation; some increase of double crop, and 90,000 acres new wet cultivation on the border of the delta, principally in Mannargudi taluk where protection against drought is hardly required; in addition 140,000 acres new wet cultivation, principally in Patukkottai taluk which badly needs protection against drought. If, as has been suggested to Mr. Higham and will be placed formally before the Commission, the capacity of the reservoir is increased from 30,000 to 40,000 millions cubic feet, an additional area may be irrigated in lower Salem and possibly in Coimbatore, both of which need protection against drought.

"6. The following is a summary of what may be accomplished if reservoirs on the two rivers are constructed and the irrigation under them confined to the legitimate sphere of each:—

Bhavani reservoir.—100,000 acres in Coimbatore which badly needs protection from drought.

Cauvery reservoir.—As before.

"7. It seems to me that the eventual question for Government to decide is whether it is better (when the silt objection has been finally met and overcome) to build a reservoir on the Bhavani which will afford a minimum protection against drought to the *exclusion* of the Cauvery, or whether the Cauvery reservoir should be constructed to do all that the Bhavani reservoir can do and in addition protect a large area of country from drought.

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† *Vide* Appendix B

Colonel, A. W. Smart.

"8. If the latter scheme is adopted, there is the additional advantage that the Bhavani will still be available to perform its legitimate function of the protection to the district through which it flows.

"9. It may be said that if both may be ultimately constructed, there is no reason why the Bhavani should not be at once constructed for Tanjore and afterwards transferred for use in Coimbatore when the Cauvery work has been made. Unfortunately it is probable that a reservoir for Coimbatore should be higher up the valley to bring the water on to the Coimbatore plain. In any case such a large reservoir would not be required."

Minor rivers.

The rivers of the second order are the Penner, Palar, Ponniar, and Vellar. Without storage, on account of their capricious nature, there is no possibility of any great increase of irrigation by direct supply.

Penner.—As stated in my note on the Tungabhadra, the possibilities of irrigation in Nellore, Anantapur, and Cuddapah will be very greatly improved by bringing in Tungabhadra water in adequate quantity. The basin of this river and its tributaries must be fully investigated for suitable sites for reservoirs. In Nellore the area of new irrigation that may be commanded on both sides of the river, if the anicut (or reservoir) is located at Somasila, will be nearly 200,000 acres. If it is found feasible to place the anicut higher up the river and to take a channel on the south side through a gap in the hills running north and south, the area commanded will be considerably increased.

Palar.—The irrigation under this river is most uncertain and is not in a satisfactory state. The large increase in the number of supplemental wells proves this. Sir Arthur Cotton proposed that Tungabhadra water, by storage in one of the branches, should be brought through Mysore territory into the basin of the Palar; whether this proposal is feasible and, if feasible, what the cost would be, is unknown.

Ponniar.—Some recent investigation would lead to the belief that a storage reservoir may be built above the Tirukkoyilur anicut for irrigation in the Tiruvannamalai taluk of South Arcot. Its capacity may possibly be from 5,000 to 10,000 millions cubic feet; in order, however, not to interfere with irrigation rights under the channels taken off the river below the anicut a second and lower anicut will be found necessary.

Vellar.—Very little is known of the upper basin of this river, especially where it passes through the Trichinopoly taluk. The recent improvement of the lower anicut on the Coleroon gives the power of greatly increasing the supply of the river at the Shatiatope anicut by filling and passing water through the Veeranam tank. This fact will have to be considered when investigation is taken up.

QUESTION 4.—*Statement showing the irrigation capacity in each district of minor works for which Capital and Revenue Accounts are kept, liability of these works to fail in seasons of drought, average gross revenue and cost of maintenance per acre irrigated.*

Systems	Districts.	Irrigating capacity.	Largest area irrigated.		Seasons of drought		Average for the past ten years.	
			Year.	Acres.	Year.	Acres.	Gross revenue per acre irrigated.	Working expenses per acre irrigated.
							Rs.	Rs.
Ganjam minor rivers	Ganjam	61,500	1900-01	59,921	1896-97	53,234	2·21	0·35
Muniyeru project	Kistna	10,580	1898-99	2,623	1899-00	878	4·00	2·42
Dondapad tank	Do.	1,680	1900-01	125	...	...	3·58	4·37
Cumbum tank	Kurnool	6,000	1898-99	5,588	1899-00	4,240	6·60	0·62
Sagileru project	Cuddapah	26,576	1898-99	4,290	1899-00	3,685	3·95	1·04
Palar anicut	North Arcot and Chingleput.	45,206	1898-99	71,882	1900-01	54,231	3·67	1·00
Poiney do.	North Arcot	20,291	1898-99	22,161	1900-01	12,286	4·04	0·91
Cheyar do.	Do.	16,771	1898-99	21,279	1891-92	16,087	4·19	1·26
Thadapalli channel	Coimbatore	13,738	1896-97	14,523	1895-96	13,936	7·49	0·59
Arkenkotta do.	Do.	4,118	1900-01	4,233	1894-95	3,999	6·89	0·87
Kalingaroyen do.	Do.	9,026	1900-01	11,400	1895-96	11,181	11·08	0·88
Chembrambakam tank	Chingleput	18,014	1898-99	12,541	1891-92	6,254	3·51	0·61
Madras water-supply	Do.	7,467	1898-99	7,197	1891-92	6,441	5·25	1·53
Vallur anicut	Do.	6,182	1898-99	4,457	1891-92	3,392	1·98	0·26
Pelandorai anicut	South Arcot	6,045	1899-00	9,854	1891-92	7,526	3·72	1·77
Vriddhachalam anicut	Do.	4,491	1898-99	6,592	1891-92	5,724	3·91	1·18
Mehamattur do.	Do.	2,724	1897-98	3,910	1891-92	2,598	4·23	2·39
Shatiatope do.	Do.	25,064	1897-98	28,982	1900-01	26,330	4·35	0·67
Tirukkoyilur do.	Do.	27,087	1893-94	23,182	1899-00	21,207	4·60	0·81
Lower Coleroon do.	Do. Tanjore	72,914	1897-98	107,282	1899-00	94,215	4·09	0·40
Marudur do.	Tinnevelly	17,920	1900-01	17,236	1892-93	14,829	10·84	1·02

Note.—Figures under irrigating capacity taken from Administration Report are not worth much.

We have often so much difficulty in getting funds for these minor projects that it would be advisable to construct some at least of them under loan funds.

The following statement (*a*) gives the projects for new works under class II works at present contemplated. Statement (*b*) sums up the possibilities of extension of irrigation in each district as known at present under questions 2, 3, and 4. It should not be taken as indicating the limit, as, no doubt, investigation will bring to light further possibilities. If Tungabhadra surplus is brought into the Penniar, irrigation of a large area of dry crop in the districts of Anantapur and Cuddapah will become possible. What this area may be must be ascertained by investigation; the area that may be commanded is at present unknown.

Colonel A.W. Smart.

(a) *List of projects for new works under "Class II Minor Works and Navigation for which Capital and Revenue Accounts are kept" examined and under contemplation.*

Serial No.	District.	Name of work.	Probable amount of estimate.	Probable ayakat.	Probable increase of revenue.	REMARKS.
		Projects examined.	Rs.	Acres.	Rs.	
1	Kistna . .	Jangamaheswarapuram tank project.	77,200	800	2,480	Sanctioned in G. O., No. 1077-I., dated 22nd December 1900. A net return of 3 21 per cent. on the total direct and indirect charges is anticipated.
		Boddalavagu project . .	...	3,500	...	Estimates are said to be under preparation in the office of the Executive Engineer, Kistna Northern Division. It is estimated to give a return of 1·94 per cent. on total capital outlay.
		Atmakur project . .	88,100	1,700	6,800	Estimate is under check in the office of the Chief Engineer for Irrigation.
2	Nellore . .	Hajipuram project . .	3,04,000	2,900	9,180	Sanctioned in G. O., No. 375-I., dated 3rd May 1901. A return of 3 per cent. on the total outlay is anticipated.
		Machavaram-Mopad reservoir	5,20,000	4,000	17,400	Estimate under scrutiny in the office of the Chief Engineer for Irrigation. A return of 2½ per cent. on the total capital outlay is anticipated.
		Ponnalur tank project . .	1,54,000	1,000	...	Anticipated return is 2·27 per cent. Sanctioned in G. O., No. 609-I., dated 20th July 1900.
		Restoring Yerur tank . .	48,400	1,236	3,443	Estimate under check in the office of the Chief Engineer for Irrigation.
3	Kurnool .	Thokapalli project . .	6,82,000	6,000	21,800	Estimate with Assistant Chief Engineer for irrigation, Tank Restoration Scheme. A trench is being excavated at site of dam to ascertain the nature of the rock.
4	Anantapur .	Hindupur project . . .	2,00,000	...	...	Estimate under preparation.
		Projects partly investigated and not yet taken up.				
1	Ganjam .	Minor projects . . .	...	50,000	...	......
2	Vizagapatam .	Constructing an anicut across Nagavalli river.	2,50,000	16,000	86,500	A return of 34 per cent. on the capital cost is anticipated.
		Reservoir on a large stream which passes Tuni in the Godavari district but drains the southern portion of the Vizagapatam district.	...	...	...	The Special Superintending Engineer states that there are possibilities for the construction of reservoirs and that the project should be investigated.
3	Godavari .	Irrigation in the Rekapalli taluk from the Saveri or its tributaries.	...	14,000	...	The Superintending Engineer on special duty states that the project is worth investigating.
		Project for utilizing the surplus of the Saveri and the Godavari.	...	...	...	......
		Project for a reservoir on the Yelleru.	...	...	...	......
		Mahadevapuram tank in Bhadrachalam taluk.	...	2,000	9,000	The Special Superintending Engineer states that an estimate is under preparation.
4	Kistna . .	Gundlakamma reservoir project (rough estimate).	13,79,000	20,000	1,22,500	A return of 6½ per cent. is anticipated. Preliminary estimates made. Channels have to be realigned. Estimates for dam have to be recast and details worked out.
		Bhrugabanda tank project .	95,200	1,500	...	A return of 4·5 per cent. is expected on the estimated expenditure.

(a) *List of projects for new works under "Class II Minor Works and Navigation for which Capital and Revenue Accounts are kept" examined and under contemplation*—contd.

Serial No.	District.	Name of work.	Probable amount of estimate.	Probable ayakat.	Probable increase of revenue.	Remarks.
		Projects partly investigated and not yet taken up—contd.	Rs.	Acres.	Rs.	
4	Kistna .	Melavagu project . .	2,00,000	2,500	...	It is stated to be a promising project.
5	Nellore .	Reservoir near Mailaveram .	...	6,500	...	A promising project.
		Mopad reservoir . . .	5,92,000	8,000	...	A return of 3·75 per cent. is anticipated.
		Supply channel to Kavali tank .	...	5,000	..	
		Gandipalem project . .	*2,00,000	5,000	...	* Preliminary estimate. The Special Superintending Engineer states that the project is a good one.
		Makerru voir . . .	...	1,200	...	The Special Superintending Engineer reports that this is an excellent and a very promising project.
		Reservoirs on the Kandaleru .	...	7,500	...	
		Reservoir on the Nerella Vegu near Cherlopalli.	...	...	...	
		Supply channel to Anamasamudram and Anantasagaram tanks.	...	500	...	
		Reservoir on the Kolleru .	...	20,000	...	
		Kondapi tank . . .	...	4,500	...	
		Pongalur Janakavaram project	...	700	...	
		Panagodu project . . .	...	1,000	...	
6	Cuddapah .	Vemula tank . . .	62,590	461	...	Expected to pay a return of 3½ per cent. on outlay. Sanctioned in G. O., No. 751-I., dated 4th October 1901.
		Vempalli tank . . .	1,38,000	800	...	
		Kanchalamma tank . .	...	422	...	
		Itodu project . . .	88,000	1 000	...	
		Dorigallu project . . .	..	4 773	...	
7	Kurnool .	Hindri project . . .	...	7,500	...	
8	Bellary .	Kolur tank	73,300	550	2,200	
		Gundabommanahalli project .	1,00,000	500	3,000	
		Iyenhalli project . . .	50,000	600	2,400	
		Proposed site for a tank on the Chinna Hagari at Hagari Bommanahalli.	...	...	...	
		Proposed site for a tank on a stream near Hadagalli.	...	...	...	
9	Anantapur .	Roddam project . . .	1,25,000	500	...	
		Restoring and improving the Yellanur tank with a proposed supply channel from the Chitravati.	1,75,000	1,150	4,600	
		Reservoir between Togarkunta and Banookota.	6,00,000	5,000	33,800	
		A tank in Peravali minor basin, Upper Penner river basin.	70,000	600	3,600	
10	Chingleput .	Project for improving the supply to Uttramerur and Edamuchi tank.	3,08,320	6,000	...	Will yield an annual return of Rs. 24,000.
		Enlarging Madurantakam tank	...	...	...	
11	South Arcot .	Toludur anicut project . .	...	...	...	
		Pakambadi anicut project .	...	20,000	...	
		Culroyen Hills reservoir . .	...		...	Require investigation.
		Reservoir near Kallakurchi .	...			
		Reservoir on Ponniar and second anicut below Tirukkoyilur.	...	30,000	...	
12	Salem . .	Krishnagiri reservoir . .	16,00,000	15,000	75,000	The return would be Rs. 5 per acre and would be less than 3 per cent.
		Vaniar project . . .	...	6,300	...	
		To cut a supply channel to the Badatalab tank.	...	2,305	..	
		Gudumalai reservoir . .	14 70,500	5,200	...	The return would be 4·4 per cent. on the outlay.
13	Coimbatore .	Amaravati reservoir . .	5,50,000	18,800	60,000	The return would be 3 9 per cent. on the capital outlay.

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(a) *List of projects for new works under "Class II Minor Works and Navigation for which Capital and Revenue Accounts are kept" examined and under contemplation*—concld.

Serial No.	District.	Name of work.	Probable amount of estimate.	Probable ayakut.	Probable increase of revenue	Remarks.
		Projects partly investigated and not yet taken up—concld.				
	Coimbatore—*contd.*	Muthikulam project . .	13,00,000	8,000	...	The project is, however, largely dependent on the decision which is to be arrived at with regard to the Bhavani reservoir. If it is decided to utilize that reservoir to supplement the supply to Tanjore, the Muthikulam scheme should be abandoned.
		Walayar project . . .	...	...	...	
		Reservoirs on the Aliyar and Uppar.	...	...	...	
14	Trichinopoly .	Reservoir across the Kulittalai Katuvari.	...	1,000	...	
		Supply channel from the Agunda Cauvery.	...	3,000	...	
		Kaduvai project . . .	...	...	...	
		Ladapuram project . .	...	...	...	
		A channel from the Cauvery .	...	...	...	
		Ponneri project . . .	...	50,000	...	
15	Madura .	Porandalar project . .	13,00,000	26,000	...	The scheme is likely to return a revenue that would cover the interest on the capital outlay.
16	Tinnevelly .	Irrigation from Vipar . .	...	...	...	
		Do. from Nambiar .	1,87,000	2,000	10,000	
		Reforming Sivalaperi and Parakramapandian tanks.	...	400	...	

(b) *Statement showing the anticipated extension of irrigation in each district.*

Serial No.	District.	Name of project.	Probable extension of irrigation.	Total extension in each district.	Remarks.
			Acres.	Acres.	
1	Ganjam .	Rushikulya project	40,000		
		Minor projects	50,000	90,000	
2	Vizagapatam .	Anicut across Nagavalli river . . .	16,000		
		Reservoir one large stream draining the southern portion of the district.	Not known.	16,000	
3	Godavari .	Irrigation in the Rekapalle taluk . . .	14,000		
		Project for utilizing the surplus of the Saveri and the Godavari.	Not known.		
		Project for a reservoir on the Yelleru .	Do.		
		By pumping	150,000		
		In delta	100,000		
		Mahadevapuram tank in Bhadrachalam taluk .	2,000	266,000	
4	Kistna .	Jangamaheswarapuram project . . .	800		Sanctioned in G. O., No. 1077-I., dated 22nd December 1900.
		Gundlakamma reservoir project . . .	20,000		
		Bhrugabanda tank project	1,500		
		Boddalavagu project	3,500		
		Mellavagu project	2,500		
		Atmakuru project	1,170		
		Divi pumping project	50,000		
		(With reservoir) Kistna	400,000		
		Delta (by improvement of duty, etc) . .	200,000	679,470	
5	Nellore .	Reservoir near Mailaveram (Pallikonda reservoir).	6,500		Will depend on areas commanded.
		Hajipuram project	2,900		
		Makerru project	1,200		
		Mopad reservoir project	8,000		
		Machaveram-Mopad reservoir . . .	5,000		
		Supply channel to Kavali tank . . .	5,000		
		Gandipalem tank project	5,000		
		Anamasamudram tank	500		
		Anantasagaram tank	Not known.		
		Site on the Neralla Vagu near Cherlopalli .	Do.		
		Kondapai tank project	4,500		
		Ponnalur ,, ...	1,000		
		Reservoirs on the Kandaleru . . .	7,500		
		Penner river canals system	26,388		
		Tungabhadra reservoir	240,000	313,488	

(b) *Statement showing the anticipated extension of irrigation in each district*—contd.

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Serial No.	District.	Name of project.	Probable extension of irrigation.	Total extension for each district	Remarks.
			Acres.	Acres.	
6	Cuddapah	Chapad project	5,000		Sanctioned in G. O., No. 376-I., dated 3rd May 1901.
		Ukkayapalli project	600		
		Vemula tank	464		
		Vempalli tank	800		
		Kanchalamma tank	422		
		Itodu project	1,000		
		Dorigallu project	4,773		
		Maidkur project	6,000		
		Development under canal	*15,000	34,059	* If discharge through the Mitakondah cutting is largely increased.
7	Kurnool	Thokapalli project	6,000		
		Hindri project	7,500		
		Velgodo project	2,900		
		Development under canal	*5,000	21,400	
8	Bellary	Minor schemes in three parts. I. Schemes investigated and estimated for.	2,673		
		II. Schemes investigated but not estimated for.	1,174		
		III. Schemes under contemplation.	2,030		
		Proposed site for a tank on the Chinna Hagari at Hagari Bommanahalli.	Not known.		
		Proposed site for a tank on a stream of some size near Kadagalli.	Do		
		Tungabhadra reservoir	30,000 (rice)†	35,877	† Also 500,000 acres dry protected.
9	Anantapur	Roddam project	500		
		Hindupur project	Not known		
		To construct an anicut across the Penner at Thimmapuram village.	Do		
		Minor schemes in three parts. Schemes investigated and estimated for.	1,206		
		Schemes under investigation	6,150		
		Do. contemplation	600	8,456	
10	Chingleput	Project for improving the supply to Utramerur and Edamuchi tanks.	6,000		
		Madurantakam tank	Not given.	6,000	
11	North Arcot	Extension of Poiney anicut system	Not known	Not known.	
12	South Arcot	By increased storage as detailed below	30,000		
		Toludur anicut project . 18,000 acres.			
		A new reservoir at Kilseruvai Not known.			
		Pakambadi anicut project 7,500 acres.			
		Kalur Kalinganeri tank . Not given.			
		Culroyen Hills reservoir . Do.			
		Reservoir near Kallakurichi Do.			
		By increased supply from Lower Coleroon anicut	20,000		
		Storage on Upper Ponniar	30,000	80,000	
13	Salem	Krishnagiri reservoir	15,000		
		Vaniar project	3,000		
		Budatalab tank	1,387		
		Gudamalai reservoir	5,200		
		Thimmapuram tank	918		
		Barur tank project	2,955	28,460	
14	Coimbatore	Bhavani reservoir	100,000		A 10,000 millions reservoir should give a duty of 100,000 acres.
		Amaravati reservoir	18,800		
		Muthukulam project	8,000		
		Walayar project	Not known.		
		Reservoirs on Aliyar and Uppar	Do.	126,800	
15	Tanjore	Cauvery reservoir scheme	300,000		
		A possible channel from the Cauvery to supply tanks in South Tanjore.	50,000	350,000	
16	Trichinopoly	Reservoir across the Kulittalai Katuvari	1,000		
		Supply channel from the Akhanda Cauvery	3,000		
		Kaduvai project	Not given.		
		Ladapuram project	Do.		
		Ponneri project	50,000	51,000	
17	Madura	Porandalar project	26,000		
		Periyar project	20,000	46,000	
18	Tinnevelly	Irrigation from Vaipar	Not known.		
		Do. Nambiar	2,000		
		Reforming Sivalaperi tank	200		
		Do. Parakramapandian tank	200		
		Srivaikuntam anicut	6,744	9,144	

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Statement showing the projects sanctioned under Class II Minor Works and Navigation for which Capital and Revenue Accounts are kept but not commenced for want of funds.

Projects.	Districts.	Amount of estimate (direct and indirect charges).	Area to be irrigated.	Anticipated return.	Authority.
1	2	3	4	5	6
		Rs.	Acres.		
Jangamaheswarapuram tank	Kistna .	77,200	300	3·21	G. O., No. 1077-I., dated 22nd December 1900.
Ponnalur tank . .	Nellore .	1,54,000	1,000	2·27	G. O., No. 609-I., dated 20th July 1900.
Hajipuram tank . .	Do. .	3,04,000	2,900	3·03	„ „ 375-I., dated 3rd May 1901.
New tank at Vemula .	Cuddapah .	62,590	464	3·50	In G. O., No. 453-I., dated 12th May 1900, this work was sanctioned under Class IV, other minor works, for which neither capital nor revenue nor individual accounts are kept, in charge of Public Works Department, but it was in G.O., No. 751-I., dated 4th October 1901, re-sanctioned under Class II.

QUESTION 5.—*Minor works for which neither Capital nor Revenue Accounts are maintained.*

District.	CLASSES III AND IV (*a*) WORKS IN CHARGE OF PUBLIC WORKS DEPARTMENT		CLASS IV (*b*) WORKS IN CHARGE OF REVENUE DEPARTMENT.		AVERAGE FOR THE LAST 20 YEARS.			Average Tank Restoration Scheme expenditure
	Number of works.	Ayakat	Number of works.	Ayakat.	Area charged as irrigated	Revenue derived.	Expenditure incurred (ordinary).	
		Acres.		Acres.	Acres.	Rs.	Rs.	Rs
Ganjam . .	115	44,494	2,482	60,754	172,091	2,30,564	40,375	.
Vizagapatam .	68	54,520	1,273	57,726	73,078	1,77,626	36,399	14,003
Godavari . .	102	45,263	1,243	51,194	89,759	1,39,715	52,280	10,899
Kistna . .	61	16,870	332	27,296	36,618	1,00,759	42,962	18,228
Nellore . .	187	74,579	304	36,293	122,698	4,09,184	1,12,938	38,588
Cuddapah .	111	56,009	2,453	153,581	195,011	6,70,366	76,752	6,292
Kurnool . .	73	20,572	310	31,473	47,088	1,59,140	24,109	29,830
Bellary . .	164	36,006	730	22,714	164,188	6,21,464	1,04,654	12,969
Anantapur .		51,243		84,340				
Chingleput .	654	235,868	1,653	124,828	332,535	7,68,045	1,14,783	1,01,953
North Arcot .	256	76,246	2,392	156,342	231,862	8,17,565	1,21,674	64,381
South Arcot .	340	103,380	2,119	181,198	326,455	11,18,367	1,87,848	31,482
Salem . .	98	29,835	1,826	86,984	111,273	3,91,379	44,520	40,815
Coimbatore .	51	59,231	71	12,347	84,947	4,46,058	62,152	53,176
Tanjore . .	53	23,034	444	38,978	59,583	1,37,091	39,613	35,673
Trichinopoly .	72	71,372	914	48,851	136,104	4,67,043	68,827	...
Madura .	172	46,391	4,915	83,245	154,022	4,99,811	61,704	92,239
Tinnevelly .	284	100,850	1,811	84,915	176,869	12,13,568	1,31,508	59,888

See pages 119—129 of Mr. Clerk's report for note on Tank Restoration Scheme by Mr. Kharegat, as also the latter's answers to Public Works Department questions of the Commission.

In my opinion a great deal too much money *on these works has been spent* under Tank Restoration Scheme. I would repair no bank under special funds, or alter or enlarge *calingulahs* or weirs of any tank which its past history shows does not breach under ordinary conditions. Ordinary bank repairs should be dealt with under ordinary maintenance. Sluices, however, with supply channels and anicuts on rivers, where they exist, should be placed in thorough order under the special funds. It is important that the supply to the tank and the distribution under it should be efficient. The mapping and statistics are most valuable and should be fully completed.

No satisfactory system of maintenance after a work has been placed in thorough order under this scheme has yet been devised. Without such it is a matter for serious consideration whether we should go on spending large sums on earthwork of banks which, without upkeep, deteriorate year by year and will again in five or six years require repairs. The subject is one of great importance and should be dealt with at an early date by the Revenue and Public Works Departments. It is possible that nothing can be done without legislation.

In this connection I would invite the attention of the Commission to the unsatisfactory state of the establishment, both local and minor, complaints regarding which are frequent in the Revenue Department. In G. O., No. 4110, Revenue, dated 18th October 1895, a scheme was formulated for establishment to work under the Revenue Department. This scheme was, however, rejected for various reasons; it was in any case inadequate. A scheme should now be devised to meet the various interests concerned, both local and minor—Provincial. One has been already put forward but has not been made the subject of consideration and discussion. In my opinion it is a matter of first importance and should be dealt with at an early date.

I would also suggest to the Commission that, if so much stress is laid on the percentage of establishment charges on work actually executed and establishment continues to be starved, investigation becomes a matter of difficulty, if not impossible. I would suggest that investigation be charged against works (preliminary expenses) and a special budget allotment made for it.

QUESTION 6.—Information is not available on the subject in the Irrigation Office.

QUESTION 7—

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Districts.	AYAKAT WELLS: GOVERNMENT, DASABANDAM, AND PRIVATE.				SUPPLEMENTAL WELLS: GOVERNMENT, DASABANDAM, AND PRIVATE.		Average area irrigated during the last five years ending with 1899-1900.	Maximum area, 1898-99.	Number of wells constructed by loans during the past decade.	Number of wells repaired or improved by loans during the past decade
	FASLI 1301.		FASLI 1307		Fasli 1301.	Fasli 1307.				
	Number.	Area irrigated.	Number.	Area irrigated.						
1	2	3	4	5	6	7	8	9	10	11
		Acres.		Acres.			Acres.	Acres.		
Ganjam . .	681	1,198	176	1,661	56	645	1,505	1,271	84	...
Vizagapatam .	...	...	...	...	3,971	2,115	...	...	18	2
Godavari .	1,633	1,782	1,149	2,009	5	61	1,912	1,665	...	...
Kistna . .	3,226	8,297	3,281	9,783	272	407	9,721	8,937	51	52
Nellore . .	9,090	59,221	13,853	51,405	938	1,184	55,855	56,135	230	384
Cuddapah .	37,222	128,273	87,926	131,413	10,190	10,287	134,844	136,204	1,772	3,534
Anantapur .	12,032	58,999	13,790	45,895	1,915	3,940	48,313	50,880	628	1,030
Bellary . .	8,072	22,134	7,955	20,306	646	631	19,188	19,444	452	317
Kurnool .	5,399	27,171	7,294	24,245	683	681	23,392	23,251	566	906
Chingleput .	10,624	19,022	12,738	28,033	10,902	12,781	24,760	28,431	4,613	850
North Arcot .	32,490	64,436	58,364	116,001	47,885	51,928	118,372	129,553	4,686	3,252
South Arcot .	34,075	62,966	48,903	79,966	25,135	22,290	73,982	77,494	1,061	712
Tanjore . .	...	...	24,891	17,458	.	29	18,547	21,532	...	..
Trichinopoly .	23,048	40,689	25,352	45,018	3,048	4,359	41,987	45,928	174	172
Madura . .	12	101,041	27,847	77,411	3,511	8,470	79,063	81,217	688	446
Tinnevelly .	34,770	68,577	43,078	73,298	3,795	5,889	78,161	82,009	1,029	584
Coimbatore .	64,084	320,854	74,123	289,739	2,369	3,215	293,683	300,325	1,693	4,887
Salem . .	45,308	43,556	46,134	65,125	18,893	20,880	70,246	72,730	618	2,095
Total .	321,766	1,031,216	446,804	1,081,796	134,214	149,792	1,096,521	1,136,996	18,363	19,223

The importance of the existing irrigation under wells may be seen by an examination of the above statement. Our information as to the yield of wells and of areas in which extension is possible is vague and unscientific. As I have already said, what we require is a hydrographic survey of each district; with such a survey, worked on scientific lines, we shall obtain reliable information and be in a position to give advice to landowners desirous of investing money in well-sinking. Mr. Jones, the Sanitary Engineer to the Madras Government, has sent me the accompanying interesting note* on subsoil water. The other notes printed are also of interest in this connection, especially Mr. Moss' valuable note on wells in Chingleput.

QUESTION 8.—Our information on the quantities of water required for different soils, for wet and dry crop, is very meagre and should be made the subject of investigation and experiment at model farms. It is the general opinion of executive officers of the Public Works Department that a great deal more water is used for rice than is necessary and that a smaller quantity would often give better results. Supersaturation of the soil is a very common error; it is generally caused by uncertainty of supply. A rayat takes his supply when he can get it, and for fear that later on he may get no supply, floods his land with an excessive quantity and tanks it in his fields for future use. For the irrigation of dry crop much less water is of course required, but how much has not been determined with any degree of accuracy. Dr. Voelcker in his report, page 75, shows that much less water is used from wells than from canals, and that a watering from a canal is 2·86 inches against 0 9 inch from a well. There is no evidence to show that the latter is insufficient, and excellent crops are raised under wells. In this Presidency the duty for rice varies from 50 acres to 100 acres per cusec; the latter would be generally the duty during a period when there is some rain.

My experience of black-cotton is that it can be irrigated just as well as any other soil, provided it is not supersaturated, and the drainage, both surface and subsoil, is attended to. It would in most cases be impossible to provide for subsoil drainage by pipes, but the same effect may be, perhaps not so efficiently, obtained by intermittent supply at long intervals of, say, ten days or a fortnight. The distributaries should be run as much as possible below general surface of ground, so that percolation and rise of subsoil spring water may not be excessive. Black-cotton is exceedingly retentive of moisture and a little water goes a long way.

Tanks in black-cotton are, I consider, possible with depths of water not exceeding 20 to 25 feet; but above this it would be necessary to put in core walls or front revetment walls with foundations taken below the black-cotton soil, the depth of which may vary from 3 to 9 feet or 12 feet. It is said that the latter is rarely exceeded. In India I would always give the preference, on account of the cracking and shrinkage of banks in hot weather, to a front retaining wall on the slope as shown in sketch. The earth behind would be put in in layers of 6 inches, watered and rammed. The core wall plus ordinary revetment in front would be more costly than the single-built revetment.

QUESTION 9.—Drainage works are still required in the three deltas, but more especially in Tanjore. The works must be undertaken from ordinary funds and not on famine relief which is, so far as our experience goes, never required in the deltas. Efficient drainage is recognized as a necessity and should always be made the subject of investigation when any canal works on a large scale are proposed. It may not immediately lead to an increase of revenue, but will do so eventually. It certainly increases produce and raises the value of land, both of which will indirectly bring in revenue. But is revenue the first consideration?

QUESTION 11.—The sketch-maps* illustrate the district programmes of relief works. These, however, as shown by Mr. Clerk in the accompanying note* are in a very unsatisfactory condition. I would recommend that a Revenue and a Public Works officer should be placed on special duty to jointly revise the programmes and, in consultation with the local officers, to ascertain local wants in the way of village tanks and wells and other works. Works that may be utilized for famine labour are railways, canals, tanks (old and new), village and road-side drinking and washing tanks, wells and roads. There is no question that the breaking of road metal is the simplest and easiest of supervision of all works suitable for the labour that is likely to come on to relief works; but if funds are available to complete a work when once begun, I would give the preference to an irrigation work. In spite of the difficulty of supervision I would, as much as possible, employ labour on village works which may afterwards be of permanent benefit to the community. For instance, much may be done to improve existing village tanks and to make new ones, but the estimates must be made beforehand and located on the village maps, so that they may be available immediately the necessity arises. The supervision difficulty may be met by making the headman of the village responsible and such works after

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* Not printed.

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a famine is over should be completed from special funds granted by Government or local bodies. A village tank as in sketch might cost Rs. 50,000 and would give work to 2,000 persons for six months.

It is generally considered that wells should not be made by famine labour. It appears to me that there may be cases in which well work may be thus undertaken, but certainly not without previous investigation and a full determination of completing the works afterwards. For instance, in a square mile of certain tracts it might be advisable to put down 60 wells at an estimated cost of Rs. 500 each—total ordinary cost Rs. 30,000. The removal of stone after blasting would be within the powers of a famine cooly. The wells would give work for three months to 2,000 persons.

APPENDIX B.

Note on utilisation of Tungabhadra surplus.

Hitherto the Tungabhadra project has been regarded as a project for irrigation in the Bellary district and has been generally condemned because—

(*a*) The people do not want rice cultivation and will not utilise water for the purpose (instances Dharoji tank and Kurnool-Cuddapah Canal). The dry crops which they prefer are cholam, ragi, cumbu, and cotton, and, under ordinary conditions of rainfall, excellent crops are raised.

(*b*) The engineering difficulties are very great and the cost for overcoming them will be enormous. If the reservoir is located on the Tungabhadra itself, there would be many villages and much land submerged belonging in great part to the Nizam. The bill for compensation would be very great. These are serious objections and they may be accepted as those generally held by all officers whether of the Revenue or Public Works Department.

2. In bad years, however, with a deficient rainfall, the rayats would take the water for saving crops, as instanced by the case of the Kurnool Canal, where, in 1876, over 90,000 acres dry were irrigated. The channel taken from Valavapur would command from 500,000 to 600,000 acres of land under dry crop and a reservoir of 30,000 millions cubic feet would be sufficient to irrigate 600,000 acres of such land. The total area cultivated in Bellary in 1900 was 2,150,917 acres. To save one-fourth of this area in a year like 1876 would be an incalculable benefit to the district.

3. The right way, however, is to deal with the surplus of the Tungabhadra as a whole and not piecemeal. If this is done, a feasible protective and productive project is possible. The engineering difficulties are great, but they are not insuperable.

Looking at the statements of surplus discharges of the Tungabhadra at the Sunkesala anicut and of the Kistna at Bezwada, we may say that 100,000 millions cubic feet are available for storage from June to October and may be utilised in the districts of Bellary, Anantapur, Cuddapah, Nellore, Kistna, and the Nizam's territory. Of this surplus 30,000 millions cubic feet may be reserved for use in the Nizam's dominions. In the absence of many essential levels and of detailed investigation, it is impossible to more than indicate generally and superficially the possibilities of the case. Of these districts, the only one in which there is any doubt with regard to irrigation is Bellary; in ordinary years it may be assumed that the water will not be used save to a small extent. On the analogy of the Kurnool Canal we may take 30,000 acres as likely to be the maximum of rice cultivation in Bellary; in years of deficient rainfall 500,000 acres dry crop may be irrigated.

4. There are three ways in which the general project may be worked out:—

(*a*) A large storage work on the Tungabhadra at Vallavapur, which is the best site yet found on that river. If this is condemned for adequate reasons, then storage must be on one or more of the branches. It will be seen from the surplus statement that a reservoir of 30,000 millions cubic feet on the main river will give at least 50,000 to 60,000 millions cubic feet and will be a much more powerful work than any combination of storage works on the branches. The channel would be taken preferably on Gordon's high level above Bellary to the Haggri; it would cross that river (on which there should also be a reservoir, if possible) and then branch into two—one branch passing down the right bank of the Haggri towards Adoni and the other across the water-shed into the Pennair. The discharge of the main channel at the head may be taken provisionally at 6,000 cusecs, or may have to be increased because of the large inevitable loss by absorption.

(*b*) The upper part or Bellary part may be dealt with separately and the Kurnool Canal improved so as to take at least 2,500 cusecs. This is a very poor substitute and is only mentioned as a possible combination. The discharge of the canal should be increased quite independently of these proposals.

(*c*) A reservoir at Vallavapur as in the first case and a high dam at Nagatur below Sunkesala or below at junction of Kistna and Tungabhadra, with cut and possibly tunnel into the Kondair, an affluent of the Pennair. In this case the upper channel for Bellary may be designed to take 3,000 cusecs and the Nagatur channel also 3,000 cusecs.

5 In Nellore irrigation will be taken up eagerly and will only be limited by the area commanded. In the absence again of levels and of detailed investigation it is impossible to say what area is likely to be irrigated. Storage will be required whether on the main Pennair or in the district itself. A 20,000 millions cubic feet reservoir on the Pennair will be filled with Tungabhadra water and with the ordinary supply of the Pennair would be sufficient filling 1½ times for 150,000 acres of rice cultivation; with good distribution the duty should rise to 200,000 acres of rice. (In the case of the Periyar, a storage of 7,000 millions cubic feet is expected to irrigate 100,000 acres.)

6. The importance of passing an adequate supply of water from the Tungabhadra into the Pennair cannot be exaggerated. It will not only bring a large tract in South Nellore under irrigation, but will steady the supply to the Sangam and Nellore channels and perhaps, most important of all, it will release the upper waters of the Pennair and branches for utilisation in Anantapur and Cuddapah. There need be no fear then that reservoirs or anicuts on the branches of the Pennair will infringe lower irrigation rights.

7. With regard to the Bellary part of the project, it may be for the present assumed that in five out of six years the water, save for 30,000 acres of rice, will not be utilised. Can it be utilised elsewhere? Undoubtedly it could either on the Kistna or Nellore for second crop. At the end of the irrigation season, when it would be certainly known that Bellary did not require the water, the reservoir could be emptied at the rate of 4,000 cusecs, of which 2,000 cusecs may be assumed will arrive at Bezwada. A portion could no doubt be utilised advantageously by the channels taking off the Tungabhadra above, including the Kurnool Canal. The 2,000 cusecs arriving at Bezwada would, in the three months at the end of the season, be sufficient for 200,000 acres of second crop and would yield a revenue of Rs. 6,00,000. (As suggested by Mr Lacey, in his answers to the Public Works Department questions, it would be well to give water in the Kistna for dry crop only and not for rice.) On the 500,000 acres dry which may be irrigated in Bellary in a bad year, a charge of Rs 2 an acre may be imposed. (In the case of the Kurnool Canal the charge for irrigating dry crop is Re. 1 per acre, but is certainly too low a rate for saving crop already on the ground) A tax of 4 annas an acre as insurance would be certainly justified for years when water is refused. It is suggested that this tax should give the right to one watering at seed time. It is often the case that deficiency of rain at the beginning of the season delays sowing most prejudicially to agricultural operations. To give water for sowing should act as a great encouragement to the regular use of water throughout the season and the gradual extension of the practice of irrigation. On this point Mr. Wedderburn in 1863 (see his report printed with G. O., No. 2773, dated 24th September 1863) said with "a prospect of water agricultural operations might com-"mence at an earlier date than they now do, because "the first ploughing depends at present on rain falling in "June and July and it often fails."

8. Judging from the figures given by Mr. Clerk and from previous partial investigations, the capital cost of all the works required for storing and utilising the Tungabhadra surplus, including minor reservoirs on the branches of the Pennair for use in the districts of Anantapur and Cuddapah, may be taken at 3 millions sterling.

On the revenue side we have—

	Rs.
200,000 acres Kistna second crop at Rs. 3 (or say 150,000 in Kistna and 50,000 in Nellore) ...	6,00,000
30,000 acres (rice) in Bellary at Rs. 4	1,20,000
500,000 acres Bellary insurance at annas 4 ...	1,25,000
In Cuddapah—	
30,000 acres at Rs. 4	1,20,000
In Anantapur—	
30,000 acres at Rs. 4	1,20,000
In Nellore*—	
150,000 acres at Rs. 4	6,00,000
	16,85,000

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* If more can be commanded, more will be irrigated.

Loss in Kistna in bad year, say, 400,000.

(It will be noticed from the surplus discharges that water may be stored in October, so that after supplying Bellary in a bad year up to October there should be some water left for Kistna, so that loss of second crop water in Kistna would only be partial.)

Gain in bad year in Bellary 500,000 acres at Rs. 1¾,

Rs. 8,75,000. This would give yearly (say)		75,000
Total revenue	...	17,60,000
Deduct for maintenance	...	3,00,000
Net revenue	...	14,60,000

or a little over 3 per cent. on capital cost.

The revenue in Nellore will be greater than shown. There will be some second crop cultivation, and as said before a much larger area may be irrigated if commanded. It may be said then under the best conditions that the project will pay from 3 to 3½ per cent. But should it fail to do so and if the percentage were reduced to 2 or even less, would not the project even then be justified? Colonel Hasted in 1883 speaking of the Kurnool Canal (see G. O., No. 184-I., dated 28th February 1883) says "in one respect it (the canal) is of greater value than can readily be estimated; that is, as a famine protective work. In the late famine (of 1876-77) the canal irrigated 90,373 acres, which without water would have been barren waste, and this when its use was not known and appreciated. In future times of scarcity it is certain that the people will avail themselves largely of the canal. It runs through districts which are some of those most liable to famine in this part of India and commands a very large tract of country, and when in the unprotected parts of these districts people are dying of starvation by hundreds and thousands who can put a money value on the produce of 500 square miles well watered". This is an aspect of the case which it behoves Indian statesmen to consider and it remains for them to say whether the general ideas of Sir Arthur Cotton, modified by our experience, should not, as regards this part of the Presidency, be carried to completion. What is now, however, required is a full detailed investigation.

Colonel A. W. Smart.

1. *Q.* (*The President.*)—You are Acting Chief Engineer for Irrigation in this Presidency?—Yes.

2. *Q.* You have had a number of years' service in Madras?—I have served the whole of my service in Madras.

3. *Q.* You have had famine experience here too?—I have only had experience in one of the minor famines.

4. *Q.* You were not in the great famine of 1876-77?—Only on the fringe of it.

5. *Q.* Our duty as an Irrigation Commission is first to consider these works which are essential or highly desirable for protection against famine; in treating these works we are not tied by any financial rules that they must pay a certain percentage, but so long as a case is shown that the country is in need of protection and that water can be given at a price which will not be absolutely unreasonable to the tax-payer, it is our duty to recommend it. Beyond that it is our duty to investigate any irrigation works that may add to the food-supply of the country, although they may not mean protection against famine; these last, I think, we must consider upon mere financial grounds; there also comes in the question of famine relief works. If it is desirable to protect a district against famine, the works should be carried out at once; if not, it may be reserved as a famine relief work. From your experience what should you say are the main works that are necessary for famine protection?—The Tungabhadra and Kistna projects.

6. *Q.* Without going into detail, what would be embraced in the Tungabhadra project?—My note has shown that it would serve Bellary, Cuddapah, Anantapur, and Nellore which are the four districts that are constantly suffering from drought; in order to protect them it would be necessary to irrigate dry crops. By developing the Tungabhadra scheme the upper channel would command about 1,400 square miles of land; if water is taken into the Penner, it would at once release the upper waters for use in Anantapur and Cuddapah; from there it would pass into Nellore where the people would gladly take it.

7. *Q.* As far as your knowledge goes there is no absolute engineering obstacle?—There are only difficulties in connection with the line of channels; but if a larger view were taken of the question, I don't think this line of channels would be looked upon as an insuperable difficulty.

8. *Q.* I understand this was a project that was practically sketched out by Sir Arthur Cotton?—Yes, it is carrying out his ideas.

9. *Q.* You have had a certain amount of survey done as regards storage of water in the Upper Tungabhadra?—Yes, for the Valvapur site; the surveys of the upper sites have been lost.

10. *Q.* Does that include the Mysore sites?—Yes, we know about them generally; they were probably sent to the Company's Board in England and have disappeared there.

11. *Q.* They may have gone to the India Office?—The surveys would not be worth much now.

12. *Q.* (***Mr. Higham.***)—Are they surveys of the sites?—The whole of the surveys of the upper sites.

13. *Q.* (*The President.*)—A part of the project is, I understand, the remodelling of the Kurnool-Cuddapah Canal?—That, I think, should be done at once without waiting for the carrying out of the rest of the project; if the distributaries are not complete, they will only be able to carry a fraction of the water into the Nellore district which would be suffering at the same time.

14. *Q.* In 1876 Nellore suffered very much?—I think two-thirds of the crops were lost.

15. *Q.* I think you have three estimates all complete in every respect for the extension of the Kurnool-Cuddapah Canal; you have the Velgode?—That is still with the Superintending Engineer; the project will have to be remodelled altogether

16. *Q.* How much water do these three projects dispose of?—Three hundred cubic feet per second.

17. *Q.* If Government approval was given to the carrying out of the necessary surveys of this great project at once, could you, with the staff you have, start the work?—We should require two Executive Engineers at least; there would be great difficulty in finding the necessary men.

18. *Q.* You have not got them here you mean?—They will have to give them and put in junior men in the divisions vacated.

19. *Q.* Do you mean the Government of Madras?—Yes.

20 *Q* They could be given?—I suppose they must give them; the investigations are more important than the ordinary work of divisions.

21. *Q.* Could the work be put in hand as quickly as possible?—Yes, it should be begun at once; we want the foundations to be examined dug before the end of May.

22. *Q* You might at once begin by securing specimens of the silts carried?—For that you will have to wait till July or August; the rivers are practically clear just now.

23. *Q.* I suppose you have already the discharge month by month of the Tungabhadra?—Yes, it is not very accurately gauged, but still it is enough for our purposes

24. *Q.* Once got into Nellore have you the means of distributing water or does it require a fresh canal?—On the south we require new distributaries; on the north side we have distributaries; there are 40,000 acres on that side that may be newly irrigated. If you put an anicut higher up, you would get a larger area commanded, but I don't know anything on that point; the Executive Engineer could give you information about it.

25. *Q.* Nellore, I understand, is a district which is specially in need of famine protection?—Yes.

26. *Q.* That group, *viz.*, Bellary, Nellore, and Cuddapah, includes the worst country?—It suffered very much in 1876-77; carrying irrigation into Nellore would be particularly productive.

27. *Q.* If we considered the thing as one project, I don't suppose for a moment it would be productive. It won't pay 4 per cent.?—Not directly, but it will pay 4 per cent if you take the indirect benefits into account.

28. *Q.* Its productiveness is in its protection against famine?—Yes, it is certain to pay 2 per cent.

29. *Q.* Can you say anything about the Kistna project?—You had better wait till you go to Rajahmundry; Mr. Reid will explain all about it. It is proposed to put a dam across the Kistna.

30. *Q.* To dam up the Kistna to form a reservoir?—Yes, to supply Guntur and North Nellore.

31. *Q.* I suppose in all these schemes we have to deal with the Nizam?—On the Tungabhadra we have, not on the Kistna. I don't think it will affect them at all.

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32. *Q.* Is the Kistna reservoir in English territory?—It may be on the border. I think there will be no difficulty there, because there is no cultivated land affected.

33. *Q.* Have you any works besides these two that you have called famine protective works?—There are a great many, but they are small projects; page 25 of Mr. Clerk's report deals with them; I don't know much about them.

34. *Q.* Are there any other major works?—The Cauvery reservoir.

35. *Q.* What about that; do you class it in the same category as protective works?—That is productive; the Bhavani is also productive.

36. *Q.* That is to say, you have no reasonable doubt that they will be financially profitable?—They are certain to pay 5 to 6 per cent. anyhow.

37. *Q.* How far have you got in the survey of this?—The Cauvery is virtually surveyed; a site for the dam has been surveyed.

38. *Q.* Have you got borings?—Borings for all the pits except one; there is no question about there being rock on the site.

39. *Q.* Have you full information about the discharge?—Sufficient information certainly.

40 *Q.* You will go on with that?—Yes, we hope to get a full investigation shortly.

41. *Q.* How about the silt?—That is one of the questions that have been raised.

42. *Q.* Can you say generally what your ideas are about storing water on the Cauvery?—It was originally proposed to store 30,000 millions cubic feet; but considering what Mr. Benson said about utilising the water higher up, I propose to increase it to 40,000 to irrigate Salem and possibly Coimbatore; the bulk of the water would go down to be used in the delta for increasing irrigation in the south.

43. *Q.* Have you got a satisfactory site for storing such a large quantity of water?—It is a very good one.

44. *Q.* Would it be in Mysore?—It is in English territory. The Bhavani project hitherto has been looked upon as a project for Tanjore; my proposal is to look upon it as a project for Coimbatore and not for Tanjore at all; then the question comes up as to where you should put the reservoir, higher up the valley or where it is just now; I cannot give full information about that at present.

45. *Q.* How much water could be stored?—10,000 to 15,000 millions cubic feet.

46. *Q.* Is there abundance of water in the Bhavani?—That amount is absolutely certain; it would work out to 100,000 acres in Coimbatore. It is rather a difficult channel on the lower site; on the upper site there is a much easier channel, I think; it requires investigation.

47. *Q.* Do you in your projects propose to grow a single crop on a larger area, or would you have a double crop on a smaller area?—I consider it is better to increase the area of irrigation than to try double cropping, especially on areas where you can get double crops by means of wells.

48. *Q.* As affording better protection?—Yes, you can get both new irrigation and double crops.

49. *Q.* These, I understand, embrace the major works; are there any others?—We know nothing about the Godavari; a great discharge from it is wasted into the sea; as far as I know two pumping schemes have been proposed.

50. *Q.* That country is tolerably well protected; there never has been any famine in that valley since the works were completed?—No; the uplands suffered a little.

51. *Q.* There may be good field for irrigation there?—No doubt there may be places for storage reservoirs on these rivers. I should say there is probably sufficient work for investigation for another 20 years.

52. *Q.* You recommend a thorough hydrographic survey of the country?—Yes; that would include rivers, &c.

53. *Q.* Have you worked out or formulated what establishment should be set to work on that?—No, I have not.

54. *Q.* Is there any other point you would like to lay before the Commission; any point on which you would like your hands to be strengthened?—There is this question about the repair of tanks. I think it is in a very unsatisfactory condition at present; there has been a great deal of money spent in the repair of tanks which have then been practically left alone. I have referred to the matter in my note. Some scheme of maintenance should be devised.

55. *Q.* You are not satisfied with the tank restoration scheme?—I think it has cost too much money especially as they don't pay any attention to the maintenance afterwards.

56. *Q.* Does that scheme come under you as Chief Engineer?—Yes.

57. *Q.* I suppose you feel that you are bound to carry out the scheme as laid down?—Yes, if you could get a system of maintenance, then there is no objection to spend money on the tanks.

58. *Q.* What is your idea about maintenance?—I think it should be done by the people themselves.

52. *Q.* By statute labour?—I don't know whether by cess or how; it would have to be considered.

60. *Q.* Can the Public Works Department undertake a larger number than they have?—I don't think so, unless you increase the establishment.

61. *Q.* You now look after those above 200 acres?—Theoretically.

62. *Q.* Are these tanks above 200 acres generally in pretty good repair?—Yes, a number were breached in the cyclone, but they did their work.

63. *Q.* It is the smaller ones that have gone to the bad?—I deny that they have gone to the bad, except in the matter of distribution; the distribution is most faulty; if you put the distribution of supply in thorough order, you don't want to do anything more.

64. *Q.* Are the sluices and masonry works generally in satisfactory order?—That is what they are taking up.

65. *Q.* Is there any other matter you would like to bring up before us?—My note, I suppose, will be considered; I have nothing to add to it.

66. *Q.* What about North and South Arcot; I understand these two districts depend chiefly on tanks which are in connection with ghat-fed rivers?—They are fed from rivers, but not from the Western Ghats.

67. *Q.* So that the rivers themselves in a time like 1876 were probably quite dry or nearly so?—They may fail partly, but not altogether. I don't know about 1876.

68. *Q.* Are many of the tanks connected with these rivers?—Yes; in North Arcot there are large systems of tanks.

69. *Q.* Are the rivers then dammed up to form reservoirs?—No; there are off-takes simply. These rivers in North and South Arcot are very uncertain.

70. *Q.* It is my impression that these two districts suffered very heavily in 1876-77. Is North Arcot much better off now than it was twenty years ago?—They have got a great deal more supplementary wells in *ayakats*, and channels have been extended to tanks.

71. *Q.* And tanks also connected with rivers?—Yes. Palar irrigation is not in a satisfactory condition I consider.

72. *Q.* What about extension on the Periyar?—There is a large area of possible irrigation if we could get extra storage; twice the amount of water could be used with the greatest advantage.

73. *Q.* Would that storage be to the west of the tunnel or to the east?—It is proposed to put it below the tunnel; the supply from another valley could be perhaps brought into the Periyar itself; that requires investigation. There is no question whatever that all the water that can be given will be used.

74. *Q.* The main object will be to extend cultivation to the right bank of the Vaigai?—No; to the left bank lower down; it would be preferable to go on extending it lower.

75. *Q.* Is that zamindari?—No; I think there are 300,000 to 400,000 acres near the sea that could be commanded.

76. *Q.* (*Mr. Higham.*)—In paragraph 1 of your note you quote Major-General Cotton's remarks that it is unfortunate in the South of India that the word "irrigation" always implies rice cultivation and you go on to say "it may be taken generally that the water required for one acre of rice will irrigate 4 acres of dry crop. The wet rate is generally taken at Rs. 4 per acre; a tax of Rs. 1-4-0 to Rs. 1-8-0 may be levied on an acre of dry crop irrigated, or, say, Rs. 5 for 4 acres dry instead of Rs. 4 for 1 acre of rice." Do you mean to say that that rate would be realized every year whether the crops were irrigated or not?—Yes, if they took to the practice of irrigating dry crops as they do in Anantapur and under wells.

77. *Q.* Though the dry crops in ordinary years get along without irrigation?—That is the theory; I doubt it. I think that they might increase the produce by 50 per cent. if they irrigated under wells. In Anantapur I was told that the outturn is now twice as great as in the neighbouring land where they don't irrigate; where they have irrigation they cultivate well; if they simply trust to rain they are careless.

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78. *Q.* In your note on the Tungabhadra project you propose to reserve 500,000 acres in the Bellary district for dry cultivation; you have assumed that they will take no water in ordinary years, but in dry years they will take a large supply?—I have assumed that, because everybody says that that place cannot be irrigated. I don't believe it. I have assumed that they will take water only in bad years in order to show that the project is possible.

79. *Q.* If water is supplied to Bellary, will there be a regular demand for the whole area for dry crops?—No; I say there will be a considerable demand. You have two railways and there is a market for their produce; the population is increasing, and so things have changed very much.

80. *Q.* Will the amount of water you contemplate passing to the Nellore district then be available; will it not be absorbed in Bellary?—No; I propose to pass 6,000 cusecs; 3,000 cusecs is sufficient for Bellary and 3,000 will be passed on.

81. *Q.* You have taken no credit for cultivation in Bellary except in famine years?—No, because of the opposition to the idea that they would irrigate there at all. If I took credit for 300,000 acres of irrigation in that part, it would be as a protective and not a productive work.

82. *Q.* I think you proposed an insurance rate of 4 annas an acre. I understand that they won't take water except in a dry year?—That is for seed time.

83. *Q.* Do you contemplate that they will take water or not?—I have purposely left that out. My belief is that they will take water there.

84. *Q.* (*The President.*)—You are showing your case as moderately as possible?—Only to show that it is possible as a protective work; my idea is that it will be a productive work eventually.

85. *Q.* (*Mr. Higham.*)—It appears to me that wherever an irrigation work is made in Madras the effect is to bring all the land under a wet rate?—Yes.

86. *Q.* Do you propose not to bring it under a uniform wet rate, but to put on a water-rate according to the crop cultivated?—It may be done in that way; it would have to be decided by the Revenue Department which way it should be done. The question is, do you admit the possibility of irrigating dry crops.

87. *Q.* That is the point I want to know; it seems foreign to the whole Madras revenue system; wherever land is brought under irrigation it is put under wet rates?—Yes.

88 *Q.* There is no opposition on the part of the people?—There is no compulsion about it; they can take water if they like.

89. *Q.* Once they have been assessed under the wet rates?—Once they have used it.

90. *Q.* Then they are bound to go on cultivating rice?—They don't do it on the Kurnool Canal.

91. *Q.* The Kurnool Canal is the one exception?—Yes.

92. *Q.* The whole tendency is to force people to cultivate rice?—Yes.

93. *Q.* I understand you want to get out of that?—Yes.

94. *Q.* What do you propose?—I should put a very heavy rate on rice; and on projects like the Tungabhadra, I should put a lower rate on other crops in order to encourage their cultivation.

95. *Q.* Would you do away with the system of permanently assessing land to wet cultivation?—That is a difficult point; I should have to think about it.

96 *Q.* When a man once took water the land would not be permanently assessed as wet as in the Godavari and Kistna?—Theoretically not.

97. *Q.* Would you propose to bar wet cultivation in Bellary?—I would put on a heavy rate.

98. *Q.* You would not have a consolidated system there?—Do you mean for dry cultivation?

99. *Q.* Yes?—The people would refuse to take water altogether. In the way I have put it I have only allowed them to take water in a bad year.

100. *Q.* You must have anticipated a great drop in the revenue whenever there is a year of good rainfall?—Some drop at all events.

101. *Q.* Why have you mentioned different sorts of revenue in the tables attached to your report?—In order to suggest a line of inquiry for you; it is a financial question; I want to suggest a line of inquiry as to whether the indirect returns are not much greater than people suppose.

102. *Q.* You give the figures for Godavari, Nellore, and Ganjam; why have you chosen these three districts?—Because these are the districts in which large works have been carried out in the last few years.

103. *Q.* These are districts in which there has been great extension of works?—Yes, at least in two of them they are very great; Ganjam is recent and Nellore is fairly recent.

104. *Q.* You have given us Godavari, because this is a district in which there has been a very extraordinary extension of cultivation?—Yes.

105. *Q.* There has been no satisfactory extension in other districts?—I gave Ganjam because of the Rushikulya project.

106. *Q.* That is a small thing?—It will have a marked effect in a few years' time.

107. *Q.* What are we to compare these figures with?—It must be done by a financial officer and made the subject of a regular inquiry.

108. *Q* (*The President.*)—They are very interesting figures?—The only thing is they are not complete.

109. *Q.* (*Mr. Higham.*)—In your note you anticipate a further development in the Kistna delta system with a reservoir to supply 400,000 acres. That does not include second-crop cultivation in the delta?—No.

110. *Q.* Do you think it is possible to get 400,000 acres of new irrigation in the uplands of the Kistna district?—I have only put that figure down as approximate. We don't know anything about the areas commanded.

111. *Q.* Referring to the Kurnool-Cuddapah Canal you say "it is advisable that this canal and its distributaries should be fully developed at an early date. For this it will be necessary to increase the discharging capacity of the canal to, say, 2 500 cusecs passing 2,000 cusecs at the Mitakondah cutting." Why do you limit the increase to 2,000?—It appears that the canal cannot take more than 1,900 cusecs; if you tried to pass the original 3,000 cusecs that was estimated for, there are certain parts of the canal that won't stand it.

112. *Q.* Why?—The banks won't stand, and from the aqueducts there is a large leakage.

113. *Q.* In order to pass 3,000 would you run the water at a greater depth or are the banks not strong enough?—You would have to run it at a depth of 8 feet where now it won't stand more than 6 or 6½ feet.

114. *Q.* The banks were not made strong enough?—No; the walls and the aqueducts were made badly; they used inferior mortar.

115. *Q.* Would it be impossible to make that good now?—I cannot say. I should say you might run it at 7 feet safely. In 1884-85 we never ran more than 6 feet.

116. *Q.* Is there any possibility of increasing the bed fall?—Yes, but not in the upper part. The fall in the upper reaches is fixed by the Hindri aqueduct.

117. *Q.* The channel could not be widened?—Yes, but at very great expense.

118. *Q.* It is a question of getting down the original 3,000; is that a matter of expense or is it a physical impossibility?—I should say myself it is best not to do it. I think it is better to get the extra quantity on the other side. I should limit it to 2,500 at the head and 2,000 at the cutting.

119. *Q.* You think you could not get more than 2,000 down at the cutting?—No, that is my opinion; it is a matter for investigation.

120. *Q.* At the head how much would there be?—2,500.

121. *Q.* Where is the difference—500?—That would be lost on the road.

122. *Q.* In what way?—By absorption and percolation.

123. *Q.* In referring to the Barur tank project you say "it would be well to ascertain if dry crop could be irrigated under this tank"?—Yes, that is to say, if there is any area commanded lower down.

124. *Q.* Why has that not been ascertained?—I don't know.

125. *Q.* It does not appear to have occurred to anybody to irrigate dry crops. There is some difficulty about this matter which I cannot understand?—The reasons are given in G.O., No. 264—17-I., dated the 7th January 1902 (read). I am quite convinced that the people will take water for dry crops in Anantapur, Cuddapah, and Kurnool.

126. *Q.* Then what do you propose to do to remove the discouragement to irrigate dry crops?—Reduce the rate.

121. *Q.* Why should the land be assessed to wet cultivation at all?—That is the normal system; the system is at the bottom of the whole thing.

128. *Q.* Supposing the wet assessment were taken off and rates charged on the crop, what would be the objection to that?—That would have to be considered in the Revenue Department.

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129. *Q.* Have you ever considered it from your point of view as a canal officer?—My opinion is that I should take a certain area under each tank which must be irrigated for rice, the area commanded by the low water-supply in the tank.

130. *Q.* Why?—Because it is more or less wet.

131. *Q* Would it not be sufficient to charge a rice rate?—Yes, as long as you prevent constant inspections; that is very objectionable.

132 *Q.* The only inspection you want is to have a record of the area cultivated?—Yes, that might be done.

133. *Q.* Is it not the case that a large part cannot be put under dry crops, because there are wet crops all round and the soil too is wet? Yes, I would have three zones: wet, dry within wet, and dry beyond. I would call it wet up to a certain contour. I am only speaking of districts like Anantapur, Cuddapah, and Kurnool.

134. *Q.* How do you differentiate?—There are districts that require real protection; the irrigated area is very small compared with the whole area.

135. *Q.* I suppose you still have a sort of desire to get as much wet cultivation as you can from a revenue point of view?—I would not try to force irrigation of dry crops where protection is not required, because in those areas a far greater proportion of the people eat rice.

136. *Q.* I am not trying to force it. I am speaking of not discouraging it. You say "Sir Arthur Cotton proposed that Tungabhadra water by storage in one of the branches should be brought through Mysore into the basin of the Palar." Supposing it was possible, would it not cut at the root of your proposal?—No, there is a large surplus.

137. *Q.* Do you mean that there is enough water in Mysore for both?—Yes.

138. *Q.* The question of bringing water into the Palar is for future consideration?—Yes.

139. *Q.* It should not be dismissed?—No; it would bring a large area under cultivation, if you brought Tungabhadra water into the Palar basin.

140. *Q.* What is your idea as a Public Works officer in regard to the maintenance of tanks; how would you propose to maintain them?—I think they should be done by the villagers. In Mysore you had some evidence to show that the villagers undertook to do the earthwork whilst the Government did the masonry.

141. *Q.* In Mysore they said they had the same difficulties as they have here and required legislation?—No doubt you must have legislation. The *kudi-maramat* system is dying out. My opinion is that it is due to the Public Works and Revenue officers not acting together.

142 *Q.* How would you resuscitate it?—You would require to have an Irrigation Act and probably a cess as well; it should be put in the hands of the local people. I think the villagers should be made to do the work of repairs; it should not be done by the establishment; it is possible to have certain lengths of a *band* done by the villagers. It only requires an Irrigation Act to enforce it At present the people do an enormous amount of *kudi-maramat* which is not recognised, but they do it; it is only expanding the system to a very small degree; they clear out their channels and they look after their sluices.

143. Q. You would not even put their banks in order?—If the history of a tank shows that it is constantly breached, then it should be repaired; if not,I should leave it alone.

144 *Q.* Supposing it does not hold water up to its proper level?—If it is shown that its capacity is reduced you must repair it.

145. *Q.* Who is responsible for saying whether a tank should be repaired or not?—If a tank is below the standard, we proceed to make an estimate.

146. *Q.* You consider that the rules want altering; the standard should be made more elastic?—Yes.

147. *Q.* Do you think more money is wanted for the Tank Restoration Scheme than they are allotted?—I am against the whole system until they have a system of maintenance.

148. *Q.* There is great trouble owing to the defective slucies of the tanks; you are not against the system of putting in new slucies?—No.

149. *Q.* Would it not be possible to provide them with proper slucies and waste weirs?—Yes.

150. *Q.* Would you put in weirs and repair the *bands* everywhere or only in places where there have been breaches?—Where there are proved defects.

151. *Q.* If you did that, would your present grant be enough to put the tanks into order in a reasonable time?—There is no reason why it should not be increased.

152. *Q.* You have estimates outstanding amounting to 11 lakhs of rupees?—Yes, investigation is three or four years in advance of execution.

153. *Q.* Could you ascertain whether that could be reduced if you threw out certain things that are not urgent?—Yes, it has to be proved.

154. *Q.* Still it is possible to get some idea?—Yes, I can get you the information. We would have to get the history of a series of tanks that have been taken up and see if they were breached or not; it would take some time.

155. *Q.* How long will that take to inquire into?—I should think about a month

156. (*The President.*)—It would be very interesting to have that information.

157. *Q.* (*Mr. Higham.*)—What is the matter you refer to in reply to question No. 5?—That has to do with the question of the reorganization of the ordinary works establishment in the Revenue Department. After a considerable amount of discussion a scheme which was formulated was rejected by the Revenue Board, because the pay of certain men would be higher than the pay of the Tahsildars. They have no proper inspecting staff.

158. *Q.* Where do they recruit the men from?—They take the men who have passed the Engineering College sub-overseer test and also lower men who have only passed the maistry test. The whole thing is in a very unsatisfactory state

159. *Q.* Then you refer further in the same page to the stress laid on the percentage of establishment charges. What do you refer to?—The Government of India are always harping of the percentage of establishment charges.

160. *Q.* Do they object to the percentage on establishment as being too high?—Yes; they have objected and the question has been inquired into.

161. *Q.* That is a question of Revenue establishment?—No; Public Works establishment.

162. *Q.* I am aware of no objections?—They have been trying to reduce the percentages and have failed. The consequence is that whenever an estimate is sent in for an investigation it is passed with great difficulty.

163. *Q.* If you have an estimate for an investigation the charge for the investigation and establishment goes against it?—It goes to swell percentage charges.

164. *Q.* Supposing an estimate is sanctioned for an investigation of the Tungabhadra scheme and you employ an establishment, how does that go?—Against general establishment charges.

165. *Q.* I think you have raised an objection that is rather an imaginary one?—It may be so. I know that any estimate that is sent in for establishment is scrutinized very carefully. They try to cut it down as much as possible.

166. *Q.* (*Mr. Muir-Mackenzie.*)—Who do?—This Government.

167. *Q.* (*Mr. Higham.*)—How would the Cauvery establishment be charged?—It has been charged to the establishment charges of the year.

168. *Q.* You say in reply to question No. 8 that black-cotton soil can be irrigated as well as any other soil: "It would in most cases be impossible to provide for subsoil drainage by pipes, but the same effect may be, perhaps not so efficiently, obtained by intermittent supply at long intervals of, say, ten days or a fortnight." We have seen a great deal of black-soil cultivation in the Deccan and found there that it was considered necessary to irrigate it very copiously?—I understand you were dealing with lift irrigation; there they give small waterings frequently; I contemplate giving one watering once a fortnight.

169. *Q.* They say that spoils it?—I am not aware of that.

170. *Q.* You say in reply to question No. 11 "I would recommend that a Revenue and a Public Works officer should be placed on special duty to jointly revise the programmes and, in consultation with the local officers, to ascertain local wants" Why cannot the famine relief programmes in the district be jointly revised by a local district and Public Works officer?—You have to find out new works; how is that possible.

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171. *Q.* Surely the local Revenue and Public Works officers can find them out; then what is the good of putting on special officers?—They have too much to do. The Collector is immerred in office work and never goes out in company with the Executive Engineer. That is one of the wants of the system.

172. *Q.* If you have a special Revenue and Public Works officer, you would want them for every district?—I should say one district could be done in three months; I would take the famine-affected district such as Cuddapah and Anantapur first.

173. *Q.* (*Mr. Muir-Mackenzie.*)—What is the character of the hydrographic survey you propose?—To ascertain the level at which subsoil water is found.

174. *Q.* How would you ascertain it; by boring?—From existing wells and also by borings.

175. *Q.* It should be done by the the Geological Department?—Yes. I don't mean that they should immediately stop a well boring in order to wait for the hydrographic survey.

176. *Q.* You consider the condition of the famine programmes altogether unsatisfactory?—Yes.

177. *Q.* In most districts?—I should say practically in all.

178. *Q.* Do you believe that the state of things is such that, if a famine suddenly supervened, the programmes would be very much discarded?—Yes, I think they would begin with road-metalling in preference to anything else.

179. *Q.* Do you believe it would be possible to prepare such a programme as would concentrate work on irrigation works in the districts?—Yes, I include village tanks and wells and things of that sort.

180 *Q.* Do you think famine labour could be employed on wells?—Yes, in particular cases.

181. *Q* Would not the wells be exceedingly scattered and difficult to supervise?—The headman of a village could supervise 60 wells per square mile.

182. *Q.* Would you not fear a good deal of eating up of the money?—That you expect in a famine.

183. *Q.* You don't think there would be more of that than in any other system?—No.

184. *Q.* Would you approve of the clearance of silt as a form of famine relief?—For very small work it would be useful, but in general it would not be a practicable scheme.

185. *Q.* (*Mr. Rajaratna Mudaliar.*)—You were referring to the minor irrigation establishment under Collectors. Are not Sub-overseers, Overseers and Supervisors selected by the Public Works Department and Chief Engineer?—No, I don't think so; they were not selected; they took the best men they could get.

186. *Q.* Did not the proceedings of the Board contemplate such an arrangement with regard to the staff?—I don't know.

187. *Q.* If that arrangement is carried out, do you think that there will be any difficulty in the selection of competent officers?—There may be very good men, but there is no inspecting officer.

188. *Q.* How many men over Rs. 150 were proposed by the Chief Engineer for irrigation?—I don't know.

189. *Q.* It was only four for the whole Presidency?—I don't know. The Board considered that it would be impossible for these men to do any useful work. They said their pay was greater than the Tahsildar's pay.

190. *Q.* And the more important reason was that they would be practically useless having such a large circle; only four men for the whole Presidency?—No doubt they were right; the scheme was an inadequate one.

191. *Q.* Is not the Executive Engineer consulted in all matters of an important nature?—Yes, if they want estimates for any masonry works.

192. *Q.* Estimates for large repairs are also sent to him for check?—Some are.

193. *Q.* Is the professional advice given by the Executive Engineers not sufficient to ensure the proper execution of these repairs?—They have nothing to do with the supervision. The Tahsildar practically supervises.

194. *Q.* And the Supervisor?—A Supervisor is kept at the head office to check the estimates in North and South Arcot; the consequence is that the whole work is done by the Sub-overseer under the Tahsildar; the Tahsildar has not the time to go and look at the works.

195. *Q.* What remedy would you suggest; would you transfer these works to the Public Works Department?—No, not at all. I propose to completely alter the whole system.

196. *Q.* By increasing the establishment?—Yes, probably. A system will have to be devised. I have not thought much about it. It requires investigation and inquiry.

197. *Q.* (*Mr. Muir-Mackenzie.*)—At any rate you would not repair tanks under 200 acres?—No; I am strongly against a retransfer of these works to the Public Works Department.

198 *Q.* (*Mr. Nicholson.*)—Things are very bad and you have not got a remedy?—The matter requires some consideration

199. *Q.* (*Mr. Muir-Mackenzie.*)—Under what department would you place the maintenance of these works?—I should like to see the whole thing brought under the Local Board.

200 *Q.* That means the Collector after all?—Yes, indirectly.

201. *Q* (*Mr Nicholson.*)—Then there would be no Public Works officer?—It is a matter that will have to be investigated. My general view is that you would have to decentralize and bring the whole of the ordinary works under the Revenue Department with the Local Fund works, and have a separate Engineer for that. The Local Fund Engineer's position would have to be raised.

202 *Q.* (*Mr. Rajaratna Mudaliar.*)—As a matter of fact, he is unable to do his own road works. Why should not the Executive Engineer do the work?—You would have to increase the establishment very much. If you wanted to retransfer the ordinary works to the Public Works Department, you would have to increase the staff and then there would be the block in promotion, after which you would have to reduce the numbers and the whole thing would have to be begun again.

203. *Q.* You say there is a divorce between the Revenue and Public Works Departments?—Yes, that has been my experience of the last twenty years. When I came out the Collector and Executive Engineer went out together.

204. *Q.* Was not then the District Engineer subordinate to the Collector?—No. Then the Engineer constantly went out with the Collector; now the Collector is too much busied in office work In my opinion that is the reason why *kudi-maramat* is dying out.

(*The President.*)—If you would give us a note on the subject in the next few weeks we should be very glad.

205. *Q* (*Mr. Rajaratna Mudaliar.*)—You said the present system of classing the land as wet and compelling the people to grow a rice crop is objectionable. Is it not the case that in years of ample rainfall, when dry lands are irrigated, the people as a rule cultivate a paddy crop. When there is a larger area of dry land irrigated, as a matter of fact, the rayats prefer to grow a rice crop?—In what districts?

206. *Q.* In most districts?—In coast districts they prefer it because they like to eat rice and in other districts they sow a certain amount of rice to pay for their assessment.

207. *Q.* You say the rayats are compelled to grow rice?—They are practically compelled to do so.

208. *Q.* But even when it is left optional with them they prefer rice?—Naturally because the profits are greater.

209. *Q.* There is nothing in the system of wet assessments which compels them to grow rice?—I believe in the *ayakats* of tanks they are compelled to grow rice.

210. *Q.* You said if it was left to them they would grow another crop?—No, I did not say that; I said you should encourage it.

211 *Q.* If it pays them to grow a rice crop?—I should leave it alone except in a district where the supply of water is limited. Where you can protect a larger area I would alter the system.

212. *Q* In this Presidency, as a matter of fact, wherever there is water they take to rice?—No; they don't do it under wells because they have to work for it.

213. *Q.* Is your present establishment in a position to spend a much larger allotment than it has at present?—You might double the allotment.

214. *Q.* The existing establishment could spend double the allotment?—Yes, you might require some petty supervision.

215. *Q.* If so, cannot they find time to investigate some of the projects that have been proposed in the last 20 to 30 years?—It is being done.

216. *Q.* In paragraph 6 of your book you give a statement of the capital outlay in the different Provinces. The net sum at charge against Madras is 83 lakhs as compared with 500 and 700 lakhs in other Provinces?—I don't know if "Navigation" is included or not.

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217. *Q.* Including "Navigation" what does your figure work to?—101 lakhs, I think.

218. *Q.* I find it is 243 lakhs including "Navigation?"—That is quite possible. Even that is small compared with other Provinces. It includes the Kurnool-Cuddapah Canal which is a dead burden on the system.

219. *Q.* With regard to the Barur project, we were told in Salem that the supply channel is not in good order?—It is possible; it was in good order when I saw it. The difficulty was that they had not extended it to some land that could be irrigated. I don't think they have found what area is commanded.

220. *Q.* (*Mr. Nicholson.*)—You mentioned the Tungabhadra scheme; is it not practically the only way by which the very arid district of Anantapur could be successfully irrigated?—It is the best way.

221. *Q.* You are unable to use Penner water on the high lands of Anantapur?—Yes, that should be investigated.

222. *Q.* Half the area of Anantapur only can be commanded by Penner water?—Yes.

223. *Q.* Have sites for the Cauvery reservoir been finally determined upon?—We have not completed the investigation.

224. *Q.* Is it possible that there may be some other sites?—There is one possible site just above.

225. *Q.* Do you remember that Mr. Thomas before the Commission of 1880 mentioned a site?—It is doubtful if there is sufficient capacity there.

226. *Q.* You will investigate that before you finally determine the site?—Yes.

227. *Q.* You propose to use Cauvery water for Tanjore and Bhavani water for Coimbatore?—Yes.

228. *Q.* If Bhavani water is used for Tanjore, then Coimbatore must go without?—Yes.

229. *Q.* Have you ever got on the track of Sir A. Cotton's investigations made on the slopes of the Nilgiris in 1828. He spent a year there and reported on the construction of reservoirs for commanding the whole of the Coimbatore district?—No. There was a report by Mr. Fraser who was on special duty.

230. *Q.* It was in the Board of Revenue, but we cannot find it?—I have not seen it.

231. *Q.* It is quoted in full in the Public Works Commission's Report of 1853?—I saw the report of 1853, but could not find the report you speak about.

232. *Q.* Cannot a great deal be done in Pattukkattai with local water?—Yes; it is proposed to have a reservoir in connection with this.

233. *Q.* With water brought into the district from the Cauvery?—The south-west supply will be from the Cauvery.

234. *Q.* Would you be able to do that from the present water coming down the Cauvery, or would you require the new storage schemes that you spoke of in the Salem district?—You must have storage tanks. You can carry out the Pattukkottai scheme without storage, but in order to carry the district over certain periods you must have storage.

235. *Q.* Referring again to the minor works establishment I think you said that, what was chiefly wanted was supervision; you have not the supervising officers?—No.

236. *Q.* You also said that the present Public Works establishment can expend much larger funds if they were provided?—Yes.

237. *Q.* That being so, why should not the Public Works Department take over minor works?—That is different altogether. If you increase the grant, it will be to take up works on which you can concentrate your labour.

238 *Q.* The present grant for establishment is 15 per cent. If it was increased to 22½ per cent., would not the Executive Engineer be able to look after the minor works of the district, excluding tanks below 15 acres?—I don't think the system is a good one at all; it does not give him time for investigation.

239. *Q.* If you had a special investigation officer such as has been proposed by other witnesses, would not the executive officer have time in his district to carry out these works?—To inspect them all.

240. *Q.* Not to inspect them all, but to deal with a certain number?—I think the system is a wrong one.

241. *Q.* Do you think that the headman of a village could supervise small village works such as the excavation of village reservoirs, clearance of silt and so forth?—I think it is the very best way to do it.

212 *Q.* The village organization is such in Madras that, with aid of a certain amount of technical supervision, they could carry out small works in famine time?—I think so, certainly.

As promised in my evidence before the Commission, I submit an analysis with diagram* of estimates under the Tank Restoration Scheme sanctioned during the three years 1898-1901. In my opinion (and this should be regarded as a personal opinion) a great deal too much money has been expended on these works, especially in the two items surplus works and earthwork. I consider that if three-fourths of the money expended on tanks had been expended on new minor projects and the extension of well irrigation the money would have been more advantageously and remuneratively laid out.

With regard to surplus works, I consider that sufficient attention has not been paid to the past history of the individual works. If a tank *band* has not breached in the past, save in an exceptional cyclone, the weir or *calingulah* in existence should have been left alone. Of course there are exceptional circumstances where the tank does not hold its full supply or where a raising of F.S. is desirable, when alterations in the old *calingulahs* or construction of new weirs would be justified. It will be found that, in spite of the work that has been already done, tank banks will breach in exceptional cyclones as they have done in the past.

With regard to earthwork, I consider that, before a regular system of maintenance had been devised and enforced, any extensive raising and widening of banks should not have been undertaken by the Government. Ordinary repairs absolutely necessary to prevent breaching in ordinary years I would leave to be dealt with by Superintending Engineers under the usual yearly grants.

I consider that all money that has been efficiently spent on supply and distribution has been well spent, and in this direction would advise that special grants should chiefly be spent in the future.

The above remarks do not apply to famine relief works. A large number of estimates have been roughly prepared for famine labour, when the necessity arises, and no better works could be found for such a contingency.

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* Not printed.

Mr. C. Benson, Deputy Director of Land Records and Agriculture.

(*Madras, 13th February 1902.*)

Mr. C. Benson.

The questions on which the Commission desires to obtain information may, in the main, be very simply stated by reference to resolution of the Government of India, No. 13, dated 13th September 1901. They are—

(1) The value of irrigation to the rayat, and to the country as a whole.

(2) How far irrigation supplies have been already utilised by Government and by private effort, and the results.

(3) What more may be done by Government to develop irrigation.

(4) How private effort may be encouraged in the construction of tanks, channels, and wells, etc.

2. In this note I propose to indicate briefly the opinions I have formed on these points. My experience ranges over the last twenty-eight years, and either from personal knowledge or authentic sources extends practically to the whole of the Presidency; but I claim no personal knowledge from observation of the Ganjam, Vizagapatam, Nellore, Malabar, and South Canara districts. Over a large part of the remainder of the Presidency, I have travelled at almost all times of the year in various capacities, which has given me much opportunity of observation, whilst my duty has made it necessary to make myself acquainted with all the available sources of information bearing on the rural economy and condition of the country.

Mr. C. Benson.

3. Into details of general information, it is not necessary for me to enter here. The statistical atlas, compiled in the early nineties, contains most of what is generally pertinent, though some of the statistics there given are obsolete, and others require revision.

My note on the rainfall of the Presidency, drawn up in 1899, with the supplement prepared this year, gives full information as to rainfall—unless detailed tables are required—and those too are available for the whole Presidency.

4. Proceeding now to the main questions as set out by the Government of India, the answer to the first can only be general. It cannot be given in reply to the detailed questions set out on behalf of the Commission, for those are in some respects inapplicable in Madras. Irrigation works, as they exist, fall into three classes; these being—

(*a*) Irrigation from canals or channels taken from our large rivers.
(*b*) Irrigation from tanks and other minor sources.
(*c*) Irrigation from wells.

The questions of supply in the first two groups of works are for Engineers to answer from their records.

5. Under canals, etc., from our large rivers, water is ordinarily available long enough to enable the rayat to grow two crops—that is, two crops of paddy, for it must always be remembered that irrigation under (*a*) and (*b*) works in Madras connotes the growth of paddy—unfortunately in some cases. This observation regarding the growth of two crops is correct of the Godavari, Kistna, Cauvery, Periyar, and Tambraparni rivers systems, though the practice varies much more than it need with regard to local conditions. A Tanjore or Tinnevelly rayat in Godavari would secure two wet crops over a much larger area than the Godavari rayat does.

Much more, then, might be done in growing two crops than is done, but the statistics compiled elsewhere will show what is done.

6. As to substitutions, it cannot be said that irrigation under works (*a*) and (*b*) leads to any such on a large scale, for paddy in itself is no more valuable than our dry grains; but it is a heavier yielder and even where no second crop of paddy is raised there are often large crops of pulses, etc., grown; though a larger extent might be, if the revenue rules encouraged it. Besides these a good deal of sugarcane, turmeric, betel, and plantains, etc., is grown under all these works, and these are much more valuable than the grain crop. But it must be noted that these are not found so much under the largest works, which tend to waterlog the *ayakat*, as under the smaller and better situated works; as an example, the irrigated land from Erode to Trichinopoly may be compared with that of the great deltas.

7. Irrigation, of course, increases the yield of a given crop, but, for the reason above given, it does not appear possible to give any direct answer to the questions of the Commission. More valuable still is its function in making the yield assured. This is to be especially noticed in connection with what are called "supplemental" wells under the smaller works with a precarious supply. But such wells are not commonly found under the larger works, though they would be most valuable there if the rayat would use them to raise his seedlings and to carry over the crop when the supplies are low.

8. Damage from over-irrigation undoubtedly occurs and probably is more extensive even than damage for short supplies, but this is a point connected with the economical use of irrigation water on which no absolute data exist. Otherwise and generally, it may be said that, so far as the northern deltas are concerned, the direct and immediate effects have been overcome, though, as mentioned above, waterlogging prevents the extension of the more valuable crops, and so far as Tanjore is concerned, inattention to drainage is complained of in parts. A good deal of alkaline efflorescence rises in places, but the areas affected have nowhere been very large, nor has the evil proved difficult to deal with. In Kistna especially there was a good deal of complaint thirty years ago, but now the complaints are confined to small areas. The fact being that drainage has been more attended to of late. It was overlooked at first, which was of course a fundamental error; but the drainage question, to which the Marquis of Tweeddale, when Governor of Madras about 70 years ago, drew attention, has never, so far as I am aware, been thoroughly investigated, and I should state the cardinal principle of irrigation to be to get water *into* the land and not *on to* it as has been considered enough heretofore. This is a question which *primâ facie* needs experimental investigation.

9. A good deal of the land under works (*a*) and (*b*) has to go without manure, but not nearly so much so as does the unirrigated land, manure naturally bringing a better return where water is available; but there is no evidence of deterioration, though of course the presumption is that way, but when land yields only at the lowest rate, deterioration is very slow. Deterioration from continuous cropping with one crop is inevitable, unless some compensation accrues. This does to no inconsiderable degree under river channels from the silt brought down by the rivers. To a more limited degree, this also occurs with tank irrigation, but one of the most valuable agencies for maintaining the productiveness of the land under paddy is the growth of pulses. In this latter respect much more might be done than is. But, generally speaking, where silt is not brought in, the dry land suffers to maintain the yield of the wet, and a heavy draft is drawn on the waste land to produce green manure.

It would be an advantage also if the rayat were encouraged to take water after harvest merely to enable him to plough up his land even if he did not grow a crop of green manure thereon. The essential aeration of the land, after taking a crop of paddy, is only secured incompletely by allowing it to dry and crack as is usual. If it were thoroughly broken up during the dry weather, the result would be most beneficial. This is done in parts of Tinnevelly.

10. Under tanks, the fact that the supplies are dependent on local rainfall renders irrigation precarious, and in the case of such works the existence of supplemental wells is of the greatest value. Many tanks have to be filled more than once in order to enable their *ayakat* to be irrigated; and in fact in consequence the crops under such, unless protected by wells, are more precarious than are those on the dry land. Under such works, the adherence of the people to the growth of paddy is peculiarly unfortunate, although in some of the most precarious tracts experience has driven them to modify this general practice, but the whole economy of the matter has never been fully investigated as it ought to be.

11. Owing to the large area occupied by the tanks themselves in proportion to the area they may water, the precarious character of the supplies generally, and the cost, there is not much room for further tank construction, but on this information is wanted from a large and systematic investigation of the irrigation resources of the country. Hitherto, irrigation works in Madras have been devoted to money-making. They yield at present an annual surplus of more than 30 lakhs of rupees over and above a reasonable interest on the capital invested, even though capital charges have been frequently debited to current expenses. The revenue seeking era is or may, therefore, very well be ended and the whole question looked at broadly. Even in the projects that are before the public, it is difficult to find any general ideas, any principles, and with the construction of every work new rights grow up which are inimical to general progress. As a cardinal case in point the Cauvery irrigation system may be quoted. The main objects now in view seem to be the expansion of irrigation and second crop in Tanjore, and much study has been given to this problem.

Now this policy appears to be one of setting the cart before the horse; and one that should be superseded forthwith. The idea may prove the best ultimately, but to deliberately accept it without investigation, as appears to have been done, seems to me to be altogether a mistake.

The Cauvery descends from Mysore to Erode with a great fall, and must at numerous points command large areas in Salem, at least. Suggestions have been made for carrying its waters through Salem to the sea in South Arcot, and what appears to be necessary is to examine and determine whether the surplus waters of the flood season cannot be taken off at high levels and distributed over a large area of upland where the crops are normally precarious.

What then is required is that each river basin should be examined *from above downwards*—not from sea coast upwards; and every possible opportunity for diverting its waters over available areas made use of. In such an investigation, opportunities for storage may probably be found by means of which the river floods may be controlled. As an instance of what may be possible the original projects of the Madras Irrigation Company for storage works about the upper waters of the Tungabhadra may be quoted. These were rejected without, so far as it appears, adequate reasons, although one of the tanks then proposed has since been taken up by the Mysore Government. The object should be to store and utilise as much water as possible as far from the coast as may be, and only as a last resort should the extension of second-crop cultivation in the deltas be aimed at. The canon of the greatest benefit to the greatest number

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should always be held in view, and not the biggest profits to the Government, as if it were a purely commercial undertaking. Profits enough and to spare there are to finance schemes on a large scale, and the security of the revenues of existing works is enough to guarantee 10 crores of loans, even if the works carried out by their aid proved absolutely unproductive directly.

12. But it is not only by the construction of works that the State can develop irrigation supplies, for every tree planted, and every acre that is cultivated more deeply and thoroughly than usual helps to lessen the rapidity of the "run off" and to make the sources of supply more certain. In these respects the Government must of course act through private owners, but in tree planting, for instance, there is no reason why much more might not be done, and better tillage may be looked for from the dissemination of information, and it will enhance the stability of the agricultural community. Irrigation in its widest sense connotes the utilisation of all supplies of water; most of these are the rain that falls on the land, and it would be to take the narrow view of the problem if the "run off" only is considered. But if the latter alone be considered, I contend that as yet we are in a state of hopeless ignorance as to the real economic duty of water; that is, how the water made available can be utilised to the best advantage, not of the individual, but of the community. Even under our largest works we are told that the duty of water for paddy is still undetermined, and it would appear that even yet the Engineers cannot say for exactly what land in Kistna water can be provided, on the basis of the empirical figures heretofore accepted.

One of the great wants of irrigation is therefore a complete system of investigation, and in connection with that it should be remembered that any good system of irrigation demands a thorough system of drainage.

13. As regards specific projects that are known of, the astonishing thing is how few these are. The development of the Kurnool-Cuddapah Canal is perhaps the most urgent, and the simplest of solution. Since I made an acquaintance with the canal in Cuddapah more than 20 years ago and with more intimate knowledge gained of it in Kurnool later, I have been of opinion that the first thing to be done is to discard the existing alignment—to put the matter briefly, if rather extremely. The policy of the past has been to get along somehow as long as expense was avoided. No courage, no broad and well-advised view has been taken of the problem, and the work has continued to carry the dead-weight imposed by its designers. I see that Mr. Clerk accepts the idea of the realignment I have long contended for; but in this case instead the first stage having been to consider the work as a whole from top to bottom, the plan of tinkering at the bottom has been followed, probably because a little more immediate revenue was expected. The canal has failed so far because it was not wanted where it was taken; not solely because it passes through black-cotton soil, but in part also because of the geological formation of the country which that soil covers. Given other and favourable subsoil conditions and the soil difficulty would have been got over, as it has been elsewhere. Take the canal where there are no such difficulties and the population difficulty will be got over.

I regard this work as one under which there is a great future for the development of irrigation on traditional lines, limited only by the capacity of the canal to carry water; but the matter must be dealt with boldly and not in a pettifogging manner. I know the country referred to better probably than any other part of the Presidency and have been over almost all of it in detail.

14. Government should then cause a detailed and careful investigation of the irrigational capacity of the country to be made on broad lines, and in this work the teachings of the Kurnool Canal failure must be borne in mind.

It should investigate the economic duty of water fully and it should investigate yet another connected question—the utilisation of our underground water-supplies.

15. Regarding the latter, comparatively little is known, but in the larger rivers, beneath the sandy-beds that characterise them, there are usually practically perennial streams draining away to the sea. The question of how these may be utilised has never been taken up, although in a few places some of them are made use of to a limited extent, as in Cuddapah and Kurnool, by means of "doravu". But the encouragement offered by the standing rules towards such utilisation is not great, and in many cases the rules are an insult to any man's common sense. One-fourth reduction of water-rate for baling may be enough for a lift of one or two feet, but for a lift of 20 feet it is nothing. The object of the State should not, in this matter, be to make revenue, but to encourage the people to utilise the water. When water is lifted it is used economically, and the benefits to the community are greatly enhanced. A deduction from the water-rates of 25 per cent. up to 5 feet of 50 per cent. up to 10, of 75 per cent. up to 15, and no charge in the case of higher lifts would be beneficial and sensible, though this scale is only suggested as indicating what appears necessary for the development of the subterranean river supplies.

16. This brings me to the question of well-irrigation, than which no more important work can be imagined as a means of protection in time of drought. Our larger rivers never fail in practice; but the smaller rivers and the tanks are from obvious reasons all more or less precarious sources. Wells too may fail, but never so immediately, nor so completely as the other sources. The value of the supplemental well has already been alluded to, and much has been done by the relaxation of land revenue regulations to encourage the sinking of these, but still the tendency to seek for revenue, rather than for benefit to the people, is apparent. In ordinary or normal years the presumption should be otherwise, but in seasons of drought the presumption in the case of our smaller works should be that the rayat has not been able to grow his crop by means of water supplied by the State, and he should not be charged unless it be proved that he has actually done so. He would then be secure in the efforts he may make to grow such small areas of crop as he may by the aid of a supplemental well. Such wells are very common in some parts, but in others are rarely seen in the wet lands, and any explanation of the fact is difficult to find; but the practice of sinking such wells is a growing one, and great liberality should be exercised in times of drought to encourage it. It is self-evident that every patch of crop raised in such a season benefits many more than the actual grower.

17. In regard to other wells, it is a mistake that some people fall into to suppose that such may be advantageously sunk anywhere and everywhere. Over large tracts the prospects of well-irrigation are the poorest, and present no chances of earning interest on the capital required, chiefly because the cost of sinking is great and the under-ground water supplies extremely scanty. But in this matter there is a want of definite and accurate information, though of course any reasonably observant man can indicate generally favourable and unfavourable localities. On the other hand, there are numerous localities in which many more profitable wells might be sunk than at present exist. By profitable wells, I mean wells from which the owners would obtain results such as would satisfy them, for very generally if a profit and loss account of well-irrigation were worked out, the balance would be on the wrong side; though, as the saying in South Indian farming goes,—

> "If the ploughman counts the cost,
> His ploughshare even will be lost."

But in regard to both matters, there is much room for exploitation and such exploitation is necessary if the Government desires to systematically encourage well-sinking as a means of protection and of improving the condition of the agricultural community.

The statistics which have been collected show the general distribution of well-irrigation, and the principal localities are Coimbatore, North Arcot, and Cuddapah, or portions of these districts. It may be noted, however, that there is every reason to believe that the statistics are still incomplete, and that any comparisons with returns for earlier years would be misleading.

18. Wells are almost entirely fed by percolation, though the distinction between springs and percolation is hard to find. The strength of the supply varies infinitely, and though the statistics on this point are not entirely reliable, they indicate the general variations; but the areas irrigable and irrigated vary from year to year with the character of the season, and the soils irrigated. It is, however, a matter of general observation that wells are comparatively rare in cotton-soil tracts, and in Bellary in such areas the waters have in many places become so alkaline as to be deleterious in use.

No such thing as the average cost of construction can be given; it may vary from Rs. 12 to Rs. 1,200 or more. It altogether depends on circumstances.

So too the duration of a well cannot be stated; there are wells which are mere temporary pits, not even lined with brush-wood; and there are huge excavations or quarries in rock. The former are ephemeral, the latter practically permanent works.

Water is raised in a variety of ways according to local custom; the commoner lifts being the *kapila,* worked on two different methods, and the *pikotta.* For low lifts, other methods are adopted. As to the efficiency of these lifts, Mr. Chatterton's experiments may be quoted.

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19. Crops grown under wells depend on the water raised and the rain that falls, but the average areas attached to, or commanded by, wells or the average areas irrigated cannot be usefully stated. They vary infinitely; though, except in the case of loan wells, no areas are attached to the wells.

When a rayat has a well, and provided the locality be one where well cultivation is taken seriously, he is enabled to grow at least two, and often three, crops in a year. The principal crops grown will be the ordinary cereals, but there will also be, at one season or another, other and more valuable crops, such as tobacco, chillies, vegetables, etc., grown to a greater or less extent.

With the cereals the yield is increased and made more certain, but much of the increase is due to the more thorough tillage and manuring of the land. In the case of other crops, it is often that the well alone makes their cultivation possible. As regards the increase of yield in different seasons, it can only be said that the better the season, the larger the area a well may benefit; although crops may be grown with the aid of well or other irrigation water alone a good rainfall is more beneficial than the best supplies by lift or by flow.

20. No charge is now made in any way for the use of underground water tapped by private enterprise, in so far as rayatwari areas are concerned, and much revenue formerly collected from this source has been given up.

21. Though there are so many wells in many places, there is no doubt that much room for further extension exists, but to bring it about demands systematic working and a bold loan policy.

As a rule, the people find no difficulty in selecting spots likely to prove good sites for wells, and test holes can be put down cheaply anywhere. Government some years ago offered expert advice, but this ended in a fiasco, but that might have been avoided.

What seems to be required is that Government should determine generally over what areas wells may be usefully sunk, and then take the matter in hand boldly. Government should not attempt to sink wells as a rule, but should work the Loans Acts systematically for the development of well-irrigation. In this, it seems to me that having determined that an area presents favourable opportunities for well sinking, the policy to adopt would be to appoint a special officer and staff to encourage and induce the rayats to take loans for the purpose.

At present this duty is piled on the shoulders of the overburdened Revenue department, the underlings of which will naturally obstruct development; and the whole of the operations have been so far spasmodic and unsystematic. No business principles have been followed, and especially the funds available have been intermittent; most iniquitously so in some cases.

All this should be changed, and much of this may be done at no real expense to the State. But prompt enquiry, prompt distribution, and generous treatment in cases of failure must be provided for. The rate of interest is quite moderate, and the period allowed for repayment long enough, if not too long.

Grants-in-aid, or remission of the advances, in cases of success, would be ill-advised and lead to corruption, but entire remission in cases of total failure should be provided for.

22. In the course of this note, some reference has been made to the suitability of cotton soil for irrigation, but a few words more may be added, although the answer to the question is that it altogether depends on circumstances. In many cases, the rayats would be foolish to abandon the dry cultivation of such land and to flood it with water in order to grow paddy on traditional lines, but this is not always the case, and, if the drainage is perfect, no such objection would arise, in case the water-supply is assured; if it is not, such a conversion would be foolish. One immediate effect of irrigating such land is to bring up the alkalies, and it needs time to wash these out. If drainage is perfect, little or no alkali will rise.

On the other soils we find in this Presidency irrigation is almost, if not always, not only innocuous but beneficial simply because the drainage is good, and the nature of the soil is such that capillary attraction to the surface is slight.

23. There are many other points connected with the main questions at issue on which remarks might be offered, but it is doubtful how far they will be entered on by the Commission. It is also a fact that almost the whole of this note is general and not specific in its application, but that is a necessity from the circumstances and it has appeared sufficiently merely to indicate the main points on which opinions or evidence can be offered. If more is desired, it can be given orally and specifically regarding any locality of which I have knowledge.

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1. *Q.* (*The President.*)—You are the Director of the Agricultural Department here?—I am Deputy.

2. *Q.* Who is the Director?—Mr. Atkinson.

3. *Q.* You have 28 years' experience of the country?—Close on 28 years.

4. *Q.* In paragraph 5 of your note you say that irrigation in Madras connotes the growth of paddy and you say "unfortunately in some cases." Does a rayat anywhere take to growing irrigated dry crops?—In the ceded districts a very considerable quantity of both ragi and cholam is grown on wet lands.

5. *Q.* Irrigated?—Yes, irrigated partly from spring channels and partly from supplemental wells, and supported partly by tanks. You will also see that similarly under the Calingaryan channel they grow a considerable amount of ragi.

6. *Q.* Not in the deltas?—Not as a rule; not on the wet lands proper.

7. *Q.* Does that distinction arise from the fact that in the ceded districts people live on ragi more than on rice? I remember that in famine times the Mysore famine coolies were fed on ragi and not on rice. I do not know whether it is the same in the ceded districts?—The people of the ceded districts prefer cholam a good deal, but ragi is also eaten in some parts.

8. *Q.* Not being rice-eaters?—Not as a rule. They have not got it.

9. *Q.* (*Mr. Ibbetson.*)—Do the peasants in the delta use rice?—In the deltas almost everybody uses rice.

10. *Q.* (*The President.*)—Mr. Nicholson suggests that the fact of growing dry crops in these districts rather suggests a precarious supply?—That is no doubt a reason.

11. *Q.* If they had more water, they would turn to paddy?—They would get more money out of the land, if they had sufficient water.

12. *Q.* But would they get more money by abandoning cholam and taking to paddy?—On limited areas they would. I do not know what people would do if they had an enormous production of rice. Whether they would sell it or eat it I cannot say. It is a matter of speculation. At present they have preferred dry grains to rice. Under the small sources that are common there, they would grow a considerable quantity of dry grains, because the water-supply is not sufficient to enable them to grow rice.

13. *Q.* They could not grow it, if they wished to?—Not under many of the sources.

14. *Q.* (*Mr. Ibbetson.*)—What do they grow under the Kurnool-Cuddapah Canal?—They grow paddy chiefly.

15. *Q.* Because they get plenty of water?—Yes.

16. *Q.* (*The President.*)—The people in the deltas are a thoroughly rice-eating people?—They have become so.

17. *Q.* Were they always so?—I cannot talk of things 60 years ago. Before the Godavari anicut was built, it was mostly a dry country, and probably they used to eat dry grains.

18. *Q.* Possibly they could not get rice?—They got only a limited quantity of it as far as we know.

19. *Q.* I suppose it would be very difficult, if not impracticable, to grow a crop like cholam in the delta lands with rice all round?—Where you have a big area of rice such as is grown, you cannot grow anything else. There would be too much water to render the growing of dry crops possible. There are, however, limited areas where you could grow them.

20. *Q.* How is it that more sugarcane is not grown?—It is partly due to the fact that there is too much water and partly also to the interruption in the supply.

21. *Q.* But sugarcane does not require water in the way that paddy does?—That is just it. It gets too much.

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22. *Q*. What about the interruption ?—There is the interruption of supply during the hot weather. Partly also to the fact that it requires a great deal more labour and trouble.

23. *Q*. I suppose there is a great deal more profit ?—But they make very good profits on paddy.

24. *Q*. In the Bombay Presidency they make wonderful profits on sugarcane ?—There is nothing like that here.

25. *Q*. Is there any reason for that ?—It is a question of manure.

26. *Q*. It is not a question of soil or climatic conditions ?—I do not think it need be.

27. *Q*. (*Mr. Muir-Mackenzie.*)—What is the reason why a large additional supply of manure could not be had in the neighbourhood of Madura ?—I hope to see a sewage farm established in Madura very shortly. I have forecasted an estimate of crops as big as yours.

28. *Q*. How will you get over the excess water ?—The land that has been selected can be drained. If you remember we went to the Teppakulam on the opposite side of the road. The land on the left hand side is the place where they propose to put the sewage farm.

29. *Q*. May one infer that if efficient drainage could be introduced you would be able to grow a larger area of valuable crops ?—Most certainly, I think so. The proportion of valuable crops where drainage is good is very much higher than it is in the deltas. Besides, coming from Erode to Trichinopoly you would have noticed that the cultivation was very much more varied there than you could see it anywhere in the deltas. They have very good drainage there and the land is very light.

30. *Q*. (*The President.*)—From the evidence before us we find that serious attention has been paid to drainage in parts of the deltas ?—Yes. The drainage that may suffice for growing paddy may not be sufficient to enable them to grow cholam, sugarcane, and turmeric.

31. *Q*. You notice in paragraph 7 that supplemental wells are not found under larger works, but are found under smaller works with a precarious supply ?—Yes. But they will be very valuable under larger works for the growth of seedlings.

32. *Q*. In paragraph 9 you say—" It would be an advantage also if the rayat were encouraged to take water after harvest merely to enable him to plough up his land even if he did not grow a crop of green manure thereon." Is water available ?—Very often a little is available in tanks. The land is at present left so hard that they cannot plough it.

33. *Q*. Is it anywhere customary to water the land before it is ploughed ?—At the beginning of the irrigation season the first thing to do is, as a rule, to water it.

34. *Q*. Before it is ploughed ?—Yes. The practice varies. In some places the land is ploughed with rain, while in others water is turned on and then the land is ploughed.

35. *Q*. (*Mr. Nicholson.*)—Which is better from agricultural point of view ?—If you can plough the land soon after the harvest and leave it broken, that is by far the best. You see it in Tinnevelly.

36. *Q*. (*Mr. Ibbetson.*)—They say that the sunning of the broken land performs the same function as the disintegration of the soil by frost in England ?—There is a Tamil proverb to the same effect.

37. *Q*. (*The President.*)—You say in paragraph 11—" With the construction of every work new rights grow up which are inimical to general progress. As a cardinal case in point the Cauvery irrigation system may be quoted." You mean that men acquire vested rights in water ?—If you encourage second crop cultivation in the Cauvery delta, you cannot work the water-supply higher up the country where it is more wanted for protection purposes.

38. *Q*. Do you personally think that some legislation is necessary to give the Government more power over its water for the good of the public ?—I have not had practical experience to speak on that point, but I should infer so from what I have heard.

39 *Q*. You say in reply to the same Question No. 11 talking about the Cauvery " suggestions have been made for carrying its water through Salem to the sea in South Arcot and what appears to be necessary is to examine and determine whether the surplus waters of the flood season cannot be taken off at high levels and distributed over a large area of upland where the crops are normally precarious." Have you any idea about the levels ? Is it feasible or are Salem lands too high ?—Looking at the level of water it is a question of cost, I should think. I do not know what the levels are accurately. That project is a very old one. It is one of Sir Arthur Cotton's list. He mentions it in 1837.

40. *Q*. I suppose Salem is a district that wants irrigation. You say in paragraph 12—" One of the great wants of irrigation is therefore a complete system of investigation, and in connection with that it should be remembered that any good system of irrigation demands a thorough system of drainage." We are all agreed in that. In paragraph 13 in talking of the Kurnool-Cuddapah Canal you say that " no broad and well-advised view has been taken of the problem." Would you realign the canal from end to end ?—After it passes through the water parting of the Kistna if you take it to the east along the contour to the foot of the hills, you will command a very large area of land that is very suitable for irrigation. There are, at present, a number of small tanks, and they would serve as nuclei to begin with and I believe that it would be a profitable undertaking. Whether you should give up the whole of the old channel is a thing that must be worked out.

41. *Q*. The old channel is used, I suppose, for pure navigation ?—It is very little use otherwise.

42. *Q*. The canal leaves the watershed of the Kistna about the 75th mile. You do not propose to realign the upstream of it ?—As far as I understand it, I do not know that you could do so. That is a question of engineering.

43. *Q*. Do you happen to know whether navigation is at all important there. Does one see many boats ?—My experience of the navigation is that one always is stranded. I had experience only once and I shall never have anything more to do with it. As to the number of boats, you could count them on the fingers of one hand. It is nothing.

44. *Q*. (*Mr. Rajaratna Mudaliar.*)—There was a company ?—Yes. But it broke up very soon.

45. *Q*. (*The President.*)—In paragraph 15you say—" In the larger rivers, beneath the sandy beds that characterise them, there are usually practically perennial streams draining away to the sea." Has any person ever proposed or carried out the building of a wall right across the bed of the stream to stop the creep of the sub-soil water of the bed below ?—I have not heard of it as having been tried.

46. *Q*. I suppose it would be protested against by the people downstream ?—I should think so, if you stop the supply to the other river channels below. Further it would be a tremendously costly job.

47. *Q*. Oh no, not necessarily. It may be a very thin wall. In paragraph 15 you say—" But the encouragement offered by the standing rules towards such utilisation is not great, and in many cases the rules are an insult to any man's common-sense." From that you infer that the water-rate is unequal ?—Yes, it is the same, whether a man lifts water 2 feet or 30 feet.

48. *Q*. (*Mr. Nicholson.*)—There is a reduction for lift irrigation and no second crop charge ?—No. But the cost of lifting is much more than that.

49. *Q*. (*The President.*)—You say in paragraph 17, talking about well-irrigation, " by profitable wells, I mean wells from which the owners would obtain results such as would satisfy them, for very generally if a profit and loss account of well-irrigation were worked out, the balance would be on the wrong side." I am surprised to read that. Is it really the case ?—That is, if you charge full rates for hire.

50. *Q*. I should not like to advise a rayat to dig a well if there is no chance of profit to him ?—It is profitable to him, because he makes certain of employing his cattle and himself. He earns 2 annas a day for himself instead of sitting idle. It is better to earn 2 annas a day than to sit idle.

51. *Q*. You do not think that all that should go into profit and loss account ?—Perhaps I should supplement that by saying that if you charge full rates for hire, you would not have profit. To the individual it is a profitable undertaking.

52. *Q*. (*Mr. Muir-Mackenzie.*)—He could not obtain full rates of hire by any other means ?—Not unless a man were to bale water for anybody else.

53. *Q*. (*The President.*)—In paragraph 21 you say—" What seems to be required is that Government should determine generally over what areas wells may be usefully sunk and then take the matter in hand boldly." Do you advocate a regular long survey of the country, geological survey ?—More or less geological.

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54. *Q.* There is some sort of geological survey?—This question of under-ground water-supply has never been touched by the geological survey, so far as I have seen the records. I do not know if it requires much geological knowledge to do it.

55. *Q.* It is difficult to know what goes on below the ground?—You have a large area where you have sufficient indications to work with, you have sufficient for practical politics, and a workable scheme, and you can go on for a long time before you need go in for boring or sinking to test what the water-supply is.

56. *Q.* That is you would observe the signs from the existing wells?—Probably I could devise a complete scheme for the Kurnool district myself.

57. *Q.* (*Mr. Ibbetson.*)—Do you think we could do it better than the people themselves?—Investigation should be with the object of determining where the Government can best push the sinking of wells. They should collect information and advance money for the construction of wells in places where they would be most productive of good results, and not simply to tell people where they should sink wells.

58. *Q.* (*Mr. Nicholson.*)—You mean that the Government should stimulate the digging of wells?—Yes. It must encourage the rayats to dig wells.

59. *Q.* (*Mr. Muir-Mackenzie.*)—I suppose observation is not made as to the depth of wells at the time of the settlement?—No, nothing about the depth of the underground water.

60. *Q.* Is not anything said in settlement reports?—I cannot remember anything myself. I have read heaps of them.

61. *Q.* (*Mr. Higham.*)—In paragraph 21 you say—"Government some years ago offered expert advice, but this ended in a fiasco, but that might have been avoided." What did they do?—A party was sent to one of the districts to bore for water and the cost of boring was something absurd. Mr. Nicholson will tell you exactly what it was. It was carried out in his district.

62. *Q.* (*Mr. Muir-Mackenzie.*)—Where is the fiasco?—On account of the cost which was abnormal, while the value was nothing.

63. *Q.* Why was the value nothing?—Because it was found that they knew no more after the boring than they knew before it.

64. *Q.* (*Mr. Higham.*)—What party was it?—A party of sappers.

65. *Q.* How long ago was it?—About 18 years ago.

66. *Q.* Is there any scope for using pumps on irrigation wells?—You mean steam pumps.

67. *Q.* Yes. Several witnesses have spoken about steam pumps?—I don't think we have information or machines that we could put into the hands of an ordinary rayat. The difficulty is about keeping the machines in order and in out-of-the-way places unless you have something very simple, that difficulty is scarcely to be got over.

68. *Q.* You must accept the ordinary native contrivance?—Yes, unless you can find something better.

69. *Q.* Perhaps you can do it on the banks of rivers where water could be raised in large quantities?—Yes. There you could afford to pay sufficiently for a good mechanic to look after it.

70. *Q.* Then I understand that as a general principle you think that the extra supplies of water that can be obtained from rivers could be employed on the extension of irrigation to tracts that do not have it rather than to increase the second crop cultivation in the areas already commanded?—That is what I think should be the general principle. The question is one of getting money.

71. *Q.* Has that principle been recognised?—Not as far as I know. Hitherto it has been a question of getting as big a money return as possible, not simply the benefit of protection.

72. *Q.* Has not the tendency been to extend the second crop cultivation?—Yes, as far as I have seen. That is my impression from what I have seen and heard.

73. *Q.* Because the channels are all ready to hand and the cost of the works will be very much less?—Yes. You get more revenue out of it. But you do not benefit so many people.

74. *Q.* (*Mr. Ibbetson.*)—In paragraph 6 you say that large crops of pulses might be grown as a second crop to a much larger extent if the revenue rules encouraged it. In what respects have the revenue rules discouraged or failed to encourage it?—Want of a little water to start the crop after the harvest of paddy. That water would be charged for if taken, just at the same rate or practically so, as if it were for a second crop, so that there is no encouragement.

75. *Q.* That is to say, water is not enough for a second rice crop but is enough to start a dry crop which can be matured without further water, and the dry crops would not pay the rice rate?—Yes, that is the discouragement.

76. *Q.* How would you alter it?—Under the more precarious sources I would say that the claims for second crop might be waived entirely for pulse crops.

77. *Q.* And charge nothing at all?— Yes.

[Mr. Nicholson pointed out that occasional floodings were not charged.]

78. *Q.* (*Mr. Ibbetson.*)—Would you let them make the best use of whatever water there is?—Yes. Especially for pulse crops, because from the manuring point of view it is important.

79. *Q.* Is it only to a certain class of sources that you would apply that?—I do not think that where you have a good supply of water it would be wise from the revenue point of view to do that.

80. *Q.* But wherever the supply is precarious?—Yes.

81. *Q.* And also wherever the supply is mainly for the first crop?—Yes, where it is registered single crop.

82. *Q.* I suppose the amount of water that will be left in precarious sources would vary every year?—Yes.

83. *Q.* It would only be in the worst year that it would be sufficient to start a second crop. In most years it would be enough for a full crop?—If it is only a single crop source, as a rule, there is only a limited quantity of water left after the crop season. It is an exception to have much water over to grow a second crop.

84. *Q.* So that your rule would not result in losing much revenue?—I don't think so.

85. *Q.* As it is, you get very little from the second crop?—Yes, in that class of lands.

86. *Q.* (*Mr. Higham.*)—Would it be necessary to do it in Kistna?—I do not think it would be necessary to do so, because there the people are certain of being able to pay easily and you must raise money for general purposes in some way or other.

87. *Q.* The supply is very precarious for the second crop. Is it not?—The supply is short, but they could grow two crops over a very large area if they choose their crops differently.

88. *Q.* (*Mr. Ibbetson.*)—Are you speaking of the Kistna delta?—Yes.

89. *Q.* Would not the land be too wet to grow a dry second crop?—I do not think you could get it at present, because when the first crop is got in the land remains too moist to grow a dry crop. But there is a very large area of second crop in the district.

90. *Q.* In the higher parts?—You see hundreds and thousands of acres of second crop.

91. *Q.* Dry second crops?—Yes. The seed is sown amongst the paddy before it is harvested.

92. *Q.* What is the seed?—It is hemp. Yellow sunn hemp—what people call zannamu. It is grown chiefly for manure and fodder.

93. *Q.* (*Mr. Muir-Mackenzie.*)—Is it charged for?—No. There are only 500 acres charged in the delta.

[Mr. Nicholson here read out the Board's Standing Order relating to this subject.]

94. *Q.* (*Mr. Ibbetson.*)—Supposing rules as to payment were altered, would it be possible for people to raise ragi and cholam on the delta land?—They would be able to grow it in a certain small proportion.

95. *Q.* Not a very large area?—I doubt whether the canals would serve a very large area. They would not let water down into minor distributaries.

96. *Q.* You spoke about the impossibility of growing dry crops in the midst of extensive rice cultivation?—In one case I was talking of one set of conditions and in the other of another set of conditions.

97. *Q.* What is the distinction?—When I said that you could not grow other crops in the deltas, I meant that it could not be done because of the wetness of the country generally. That is, from July to November or December, when the whole country is a sheet of water up to a certain level. On the other hand, after the paddy is harvested, the fields are gradually drying up because the water is cut off. After that time the water-supply is limited and with

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t you could grow dry crops on such limited areas as you could get water for.

98. *Q.* The soil does not remain wet throughout the year?—No. The whole of the delta system is that they want it thoroughly dry. For instance, in Tanjore and all over the country where you have deltas they want the land to dry thoroughly.

99. *Q.* From an agricultural point of view are alternative crops of rice and maize preferable to two crops of rice, so far as the welfare of the land is concerned?—You would keep the land in better condition. I do not think we have sufficient facts to show whether the former would be preferable, but it will certainly keep the land in very much better condition.

100. *Q.* So that it would be advantageous from the agriculturist's point of view?—Yes.

101. *Q.* (*Mr. Muir-Mackenzie.*)—Would it result in a larger yield than rice?—It depends on water. You could not get rice and rice unless you have a very large supply of water. But you can get rice and cholam with a small supply.

102. *Q.* (*Mr. Nicholson.*)—Where there might be a little water left in the tank after the first crop, why should not the people carry out under tank irrigation the same system that they observe in Kistna, of growing pulses mixed with paddy just before harvesting, instead of being supplied with water free. Why should they not adopt the method that they adopt in Kistna?—Why should we have to give them water free while in Kistna they do without it?—I look upon what is done in Kistna as an evasion of the rule. In order to get a crop it is much better to plough the land and sow the seed afterwards.

103. *Q.* Are they able to do so?—They are able to dodge the rule.

104. *Q.* Can they do it under tank irrigation?—Yes, they can.

105. *Q.* Do they grow a crop in that way in Dharapuram and under some of the Amravati channels?—Yes, and in Trichinopoly also.

106. *Q.* And also horse-gram crop in many cases?—I did not say that.

107. *Q.* But it is possible?—Yes, it is possible. They grow it in Godavari.

[Mr. Nicholson here read out the Board's Standing Order on the subject.]

108. *Q.* With reference to the Kistna channels, is it not one of the reasons why a second crop could not be grown that the channels are closed for clearance so long a time?—I don't think that would necessarily prevent it.

109. *Q.* But the fact remains that they grow a five months' paddy and keep the single crop so long on the ground?—They start so late and keep it so late.

110. *Q.* (*Mr. Ibbetson.*)—You say in paragraph 8 that "so far as the northern deltas are concerned the direct and immediate effects have been overcome." How have they been overcome?—That is, by paying attention to drainage as far as I know.

111. *Q.* You go on to say that the water-logging prevents the extension of the more valuable crops. By that you mean that you could not have garden crops in the midst of rice cultivation?—Yes.

112. *Q.* That is due to the fact that the whole place is a sheet of water?—Yes.

113. *Q.* It is not necessary that the whole place should be a sheet of water. Supposing water was economised and supply was restricted to what was necessary for the cultivation of rice, do you think that the cultivation of garden crops would be impossible?—It is a matter of belief and I cannot say it is proven. I believe you could do so, but I do not see how it is to be practically carried out.

114. *Q.* Why?—Because it is the custom of the country. You have got the custom of the country over an enormous area of land, and I do not see how you are going to get over that.

115. *Q.* You mean that even if the people could grow more valuable crops they would not do it, rice cultivation being the custom?—The general custom is the growth of rice and that prevents anyone else from growing any other crop.

116. *Q.* Why?—Because of water.

117. *Q.* You are inclined to think that if water was limited to what was actually necessary for rice that would not interfere with the cultivation of garden crops?—Yes, provided you can have drainage.

118. *Q.* Suppose there are tanks which are entirely in the hands of people who depend on them and therefore use water more economically than in widespread irrigation in the delta, is it not true that they grow a good deal of garden crop such as sugarcane?—Under certain tanks they do. But I do not know if water is more economically used. I have heard an engineer say that the water is least economically used, because the distribution is bad.

119. *Q.* When they do not go in for mixed cultivation, is it because they have not got the means?—Generally speaking, where you find mixed crop cultivation under a tank, it means that the drainage is very good.

120. *Q.* So that you could not argue from that in regard to the delta?—It is not so easily managed in the deltas.

121. *Q.* Then we return to the other point. You say that where it is possible to grow these valuable crops people did not care for them. I don't quite understand why when they could do so they would not do so in a rice tract?—If they could do it, they would grow very much more of them. If they are not prevented by too much water, I believe they would.

122. *Q.* Do you think they would gradually extend?—Given the conditions, they could extend.

123. *Q.* So that at any rate it would be quite worth while doing our best to restrict the supply of water to the rice area to the minimum that is required and see whether, as an experiment, they could not grow more valuable crops?—I believe it would be a very good thing if you could work it out.

124 *Q.* Under canal irrigation in parts where I was accustomed, cane and rice were grown wholesale side by side, cane on higher parts and rice on lower parts. What is the practice here?—In the deltas you find that on the higher portions turmeric and cane are grown to some small extent. But possibly the conditions are not exactly the same.

125. *Q.* (*Mr. Muir-Mackenzie.*)—Do they never go in for the system under smaller channels which we call *bandharas*, of growing rice in one year and cane in another on the same area?—Cane is practically never grown continuously on the same land.

126. *Q.* They divide practically the whole of the land into bits and split it up—one for cane, one for rice and the third for yams?—There is a tendency in some places to get things together for the purpose of the convenience of supervision and watching. Further than that I do not think it is common.

127. *Q.* (*Mr. Nicholson.*)—The reason why the rayats cannot grow sugarcane on a rice flat is that water flows from one field to another on the surface?—No doubt it flows all over the country.

128. *Q.* If you grow sugarcane in the middle which requires water to be taken off and drained, you would deprive the neighbouring fields of their accustomed flow of water?—You cannot drain the cane fields in the Godavari delta for that reason. Water gets into the field and you cannot get it out.

129. *Q.* (*Mr. Ibbetson.*)—When you say that water flows from field to field you do not mean that the flow of water is continuous in both the fields?

Mr. Nicholson.—Yes.

130. *Q.* (*Mr. Ibbetson.*)—I have never seen that sort of rice irrigation in my life. Is that necessary?

Mr. Nicholson.—That is the universal method adopted here.

131. *Q.* (*Mr. Ibbetson.*)—That is injurious. Is it not?

Mr. Nicholson.—That is the only method adopted here.

132. *Q.* (*Mr. Ibbetson.*)—Would it not be possible to introduce a change? In the deltas you adopt the swamp method. But under the tanks where the water-supply is limited, would you adopt the same method?

Mr. Nicholson.—We do the same thing.

133. *Q.* (*Mr. Ibbetson.*)—Is no rice grown except by swamp method?

Mr. Nicholson.—No.

134. *Q.* (*The President.*)—What I cannot make out is the high duty of water. We have heard from Mr. Chatterton that there is no reason why we should not get from 90 to 100 acres for rice.

Mr. Muir-Mackenzie.—In Gujerat they say that the more water there is, the more rice.

135. *Q.* (*Mr. Ibbetson to Mr. Higham.*)—What do you

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say about the necessity for swamp irrigation, the submersion of the whole area?

Mr. Higham.—I went into that question some time ago. I think where rice irrigation is practised on an extensive scale, as is done in Madras and in Bengal, the swamp irrigation is the only way in which they could do it. We do not do it that way, because the percentage of rice would be small. The difficulty they have in Madras such as involuntary irrigation and that sort of thing appears in very small form in Bengal, where irrigation is almost entirely rice. Water is let on from one field to another. I have no doubt that is the most economical way of doing it. I do not think you get water on the fields as constantly and regularly if it is put on by separate depths as is done in some places up-country.

136. *Q* (*Mr. Muir-Mackenzie.*)—The rice of Bengal is mostly rain-fed. It is not produced by irrigation from rivers or channels?

Mr. Higham.—Yes. On the Sone Canal in Bengal they have a system of giving out land on leases of 7 years and they cannot follow the water to see what particular fields are to be charged. They give out land in blocks and it is assumed that every field in that block would take water. At any rate they charge for it. It may happen that some of the individuals in that block do not want water. They refuse to sign the application for leases. Then they would not give the block; they would not give it out on lease until everybody signs the application. It is quite in the power of two or three individuals to prevent the whole block being given out. As a matter of fact, in Orissa, that was found to be a very serious difficulty. In Bihar pressure is put on by the other cultivators and as a rule the whole block is given out. Practice in both the provinces is that unless everybody in the block joins in the application and renders himself liable to water-rate, the water is not given at all.

Mr. Nicholson.—Mr. Benson is very anxious to alter the system of swamp cultivation?

137. *Q.* (*Mr. Ibbetson.*)—Your main reason for describing the growth of paddy cultivation as "unfortunate" is, I understand to be, that it monopolises an immense deal of water which, if supplied to other crops, could be made to cover a much larger area and to benefit a much larger number of people?—Yes.

138. *Q.* You say in paragraph 10—"under such works, the adherence of the people to the growth of paddy is peculiarly unfortunate." That reason which you have just given does not apply to that case apparently because the water belongs to a limited number of people and even though they use it for dry crops it would not go to anybody outside?—It would go further down; it would go over a larger area.

139. *Q.* But it would be within the same village?—It may be within the same village. But it will benefit a number of people.

140. *Q.* To a certain extent?—Yes.

141. *Q.* As regards the benefit to the people, I thought that the rights in water were all taken up, so that if you did economise it by growing dry crops instead of wet, it is only the right-holders that could use this surplus that is created?—If water is available in the sources, it can be taken to any land outside the *ayakat* with permission.

142. *Q.* Whose permission?—Generally of the village headman.

143. *Q.* Do you mean to say that a man who had no right at all to water can take it?—As soon as their needs are satisfied, dry lands may be watered. It is done in the villages to some extent when there is plenty of water. You may take the water to dry lands beyond the *ayakat,* in which case a water-rate is charged.

144. *Q.* (*Mr. Higham.*)—Wet land must have a prior claim?—Yes.

145. *Q.* (*Mr. Ibbetson.*)—You don't think that the villagers know best as to how to make the best use of their water. Although their rice crop might fail occasionally, yet they must get more out of rice even allowing for that failure than from dry crops. Otherwise they would change their practice?—The agricultural world is hidebound by custom.

146. *Q.* Even where the profit is in question?—Here you have a custom of growing paddy. The question is: has anybody ever thought whether that water could benefit a larger area taking the average of seasons if you had adopted something different. It is a question whether it has come home to the rayat that his present habit is injurious.

147. *Q.* Your personal belief is that if the rayat could be induced to grow dry crops he would find it more profitable under precarious sources?—He has found it so in some places. We have experienced that he does it in some places. What I would urge is that he should be encouraged to do it.

148. *Q.* How would you encourage him?—By saying that if you grow any other crop but rice, you would have a reduction in assessment.

149. *Q.* Which would be reasonable from the point of view of Government, because he would take less water?—Yes. It is better to make certain of low assessment for whole than full assessment for a part.

150. *Q.* To come to these supplemental wells, I should like to ask you the same question as I asked some of the witnesses. If you had a lakh of rupees to spend on wells for the protection of the district, would you spend it on supplemental wells in the *ayakats* of tanks or spend it on independent wells in places where there is no protection at present?—It would depend very largely on the districts. In the Karnatic districts, I should prefer to spend it on supplemental wells, because the tanks are so shallow that water does not hold out.

151. *Q.* (*Mr. Muir-Mackenzie.*)—Which are the Karnatic districts?—From Nellore to Tanjore.

152. *Q.* The coast belt?—The East Coast belt.

153. *Q.* (*Mr. Nicholson.*)—Would you include Salem and North Arcot in the districts which ought to be provided with supplemental wells?—There they follow the practice very fully already. But there are other parts where there is small opening for supplemental wells. I would encourage it wherever there are small or shallow tanks.

154. *Q.* (*Mr. Ibbetson*).—Your answer comes pretty much to this; wherever supplemental wells are wanted, you would prefer them to independent wells?—Yes, because you will get better value for the money.

155. *Q.* Not merely better value for the crops, but better value in the form of protection against famine?—Yes, certainly.

156. *Q.* Suppose you have the tank *ayakats* thoroughly well supplied with these supplemental wells and you are growing garden crops, a valuable sort of crop, do you think it is a waste to give the tank supply to the land already protected by wells; do you think it is a waste to give both the underground and the aboveground supply?—Given the fact that you are growing garden crops, you would not need to give tank water to that land.

157. *Q.* Can you then take the tank water past the wells to other lands?—It is a possibility.

158. *Q.* You don't think it would be advisable?—It is rather difficult to say. If you have garden crops on the whole of the *ayakat,* then you could run the water in the way you suggest.

159. *Q.* Having got the garden crops under wells, the tank water would not be needed?—Not generally. They might run the water from the tank to save themselves the trouble of taking water from the wells.

160. *Q.* In reply to Question No. 13 in regard to Cuddapah-Kurnool Canal you say—"the canal has failed so far because it was not wanted where it was taken; not solely because it passes through black cotton soil, but in part also because of geological formation of the country which that soil covers." What is the geological formation of the country?—Almost the whole valley down which it runs is underlain with sedimentary rock, which is impermeable, so that you don't get any drainage.

161. *Q.* Speaking of the means of using the underground supply, you say in paragraph 15—"but the encouragement offered by the standing rules towards such utilisation is not great." You tell us presently of one difficulty, namely, there is no difference of rates. Is that the only respect in which you would like to improve it?—If the extra cost to the individual utilising it is recognised, I do not think that you need go further.

162. *Q.* In insecure places where famine is frequent, do you think it would be reasonable for Government to waive the claim for water even at the expense of others?—I do not know.

163. *Q.* What are your most insecure districts?—Anantapur and Bellary.

164. *Q.* In Anantapur if you could, by extending irrigation, reduce the famine expenditure it would pay Government to give a small bounty to irrigation. That being so, is it wise that the Government should continue to restrict irrigation and not give a bounty but to charge royalty on the use of any water that is not wanted

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elsewhere and by the use of which the supply of no other source is diminished?—I do not see why the Government should give something for nothing.

165. *Q* It might relieve the people and the Government will get back the profit during famine. Every acre of added irrigation reduces the famine expenditure?—In every famine the rayats who hold protected lands make large profits from them and there is no reason why they should not contribute to the support of other people.

166. *Q*. Suppose the royalty charges are taken off, much more extensive use would be made of the subsoil water than is made?—That is the charge on the river channel. It no doubt would. In some places it must keep men back from irrigation. The extra charge is Rs. 3 or Rs 2-4-0 according to the class of the river. Rs. 4 is the full rate, and there is the reduction for lift.

167. *Q*. Do you think if that were done you will get an increase?—There will be.

168. *Q*. You still think that it would be a mistake on the part of the Government to remit it?—It depends on where it is and how much the amount is.

169. *Q* I am speaking of insecure tracts?—I do not see why the Government should give up everything. Considering the extent to which the rayat is benefited, there is no reason why he should not contribute towards the general purse.

170. *Q*. You would, as a matter of fact, relinquish the power of reducing the famine expenditure for fear of causing men to use water without paying anything and thus making them too rich?—That is not the way I would put it.

171. *Q*. (*The President.*)—Does it not resolve itself into this; if men are deterred by this rate, our policy should be to lower or abolish the rate.

172. *Q*. (*Mr. Nicholson.*)—Under the Gundlakamma river where there are no rates, there are more *doruvu* wells than elsewhere?—Yes. In Markapur all along the banks it is full of them. That is a precarious tract.

173. *Q*. (*Mr. Muir-Mackenzie.*)—If a man digs a well, if it be not inside the bank, he would not be charged anything?—Yes, because it is on his own land. There is plenty of water in the bed of the river Palar and also within a certain distance from the bank. The fear of being charged keeps the men off from the bank of the river.

174. *Q*. (*Mr. Ibbetson.*)—The bank of the river is not private land?—Up to a certain limit it is public land.

175. *Q*. In paragraph 17 you point out "over large tracts the prospects of well-irrigation are the poorest, and present no chances of earning interest on the capital required, chiefly because the cost of sinking is great and the underground water-supplies extremely scanty." Take the Deccan districts, which are four. What proportion of cultivation is so situated as to be protected by wells? You can only give the roughest possible estimate?—I doubt whether you would get more than 3 per cent. of the area of cultivation in the ceded districts.

176. *Q*. Even if the money were unlimited?—Yes, perhaps rather more than I said. I would consider a little further.

177. *Q*. In the ceded districts what proportion of cultivation is so situated as to be capable of being protected by wells if money were unlimited. That is the question you have to consider. There is also this question. I suppose in these ceded districts there are considerable areas which are physically unfit for irrigation, being too rocky or too high or being too poor soil. Can you give us any idea as to what proportion of cultivation is included in areas of that sort or deep black cotton soil?—Given the water, it is a very small proportion of the area that would not be benefited except where you have black cotton soil.

178. *Q*. There is very little area unfit for well cultivation except black cotton soil?—There are areas where it is a physical impossibility to take water to.

179. *Q*. (*Mr. Higham.*)—You mean the lift is too great?—The land is much higher than the level of any water that is within the range.

180. *Q*. (*Mr. Ibbetson.*)—In Bombay Deccan there are large areas which you could not irrigate even if you had the water?—It is a question of time.

181. *Q*. The sort of case that I am contemplating is poor shallow soil?—I do not know whether there is any large proportion of land actually under cultivation which could not be irrigated. I do not say it could be profitably irrigated. It would involve an enormous expense to bring it under irrigation.

182. *Q* Then there is no obstacle to irrigating the kind of land that I am speaking of?—Given the water and time, there is no obstacle.

183. *Q*. In paragraph 18 you decline to commit yourself as to the average cost of a well or the average life of it or the average area watered by it?—If you would ask me something more definite I would answer.

184. *Q*. Taking an ordinary well 20 feet deep with no obstacles, there being fairly soft rock—I suppose that is the ordinary average well that you get in insecure parts of the Madras Presidency and it is only with insecure parts I am concerned—what would be its average cost?—The average cost of a well would probably run up to Rs. 400.

185. *Q*. How much would be the masonry?—It depends upon circumstances—how friable the nature of the soil is. Sometimes you get loose gravel which runs down to some distance. In that case as far as it goes you will have to revet it.

186. *Q*. All round?—Probably all round. Sometimes you get into harder rock. When I said Rs. 400, I was thinking of a case in which you would have to build a considerable amount of revetment.

187. *Q*. If he has to build less, it would cost less?—Very much less. It may be done for Rs. 200.

188. *Q*. Is it not a fact that excavating rock is more costly than revetting?—That depends. You may get a rock which you can excavate without very much expense and yet would stand exposure.

189. *Q*. I mean the ordinary rock which is generally met with in the Deccan?—If it is very hard rock you will have to give it up and try another site.

190. *Q*. I will take a well such as I have been considering, with all those precautions taken and with nothing costly about it, the expenditure being economically applied and the annual repairs being reasonably made, how long would that well last?—It may last absolutely indefinitely. It will certainly last fifty years; and it may last even one hundred and fifty years.

191. *Q*. You think it might be expected to last 50 fully?—Yes. I would leave it absolutely indefinite. There are large number of wells which are over a hundred years old.

192. *Q*. You know that as a fact?—They were there before the British Raj began.

193. *Q*. How do you know?—Because there were grants of land and such wells as were attached to the land are mentioned in the grant.

194. *Q*. Have they anything more in the way of masonry than the sort of thing you have been building or are they *pakka*-built ones?—They are built in stone.

195. *Q*. With mortar?—I am not sure about the mortar.

196. *Q*. They would cost more than four hundred rupees?—Yes, they cost more than a thousand.

197. *Q*. Do you know if these wells have anything more than protection on the môt side?—I cannot say; that depends upon the rock.

198. *Q*. About the area which is annually irrigated from the well. Taking the well to be 20 to 25 feet in depth in the ceded districts, what area could it irrigate?—Probably 4 acres.

199. *Q*. As much as that on an average?—Yes, given water-supply.

200. *Q*. Not more, however good the supply?—You may run up to six.

201. *Q*. On a single môt?—At one time of the year you may get up to six immediately after the rains, but at other times it runs down to three in the case of a hot weather crop.

202. *Q*. Supposing there is a year of drought and they substituted fodder crops for the good deal of more valuable crops, how much area could they extend?—I don't think you could get a very much larger area except that you could get more crop and more cuttings.

203. *Q*. Not much more area?—No. Cholam would be the chief crop if they grow it for fodder.

204. *Q*. (*Mr. Muir-Mackenzie.*)—Garden crops are grown comparatively little?—One crop is almost always a

grain crop. Another crop is a mixed one. Some part of the area will be under the garden crop and some will be under grain.

205. *Q.* (*Mr. Ibbetson.*)—You speak of the system of Government advances. You say "especially the funds available have been intermittent; most iniquitously so in some cases." What are you thinking of?—I am thinking of 1892 when Government had undertaken the grant of a very large number of loans and the order went out that all second instalments were to be stopped because funds were short.

206. *Q.* So that a man who had started on first instalment was not given the second and had to stop?—I do not know it personally, but I had it from the Collector of the district who had the biggest advances out and he said it was a most terrible set-back that he ever had to the promotion of wells. The money was provided in the end, but it was too late; by the time the grant was finally given the damage done was great.

207. *Q.* Setting aside that particular instance, as to which I quite agree with what you say, is it your experience that the funds generally available were unequal to the demand. You do not happen to know sufficiently; do you?—As far as I have been able to watch these things, no man has been able to know how much money he could get.

208. *Q.* You think there have been cases of people who were prepared and willing to take money and money could not be had?—Not sufficiently soon. Very often applications had come in. They had to defer the grant.

209. *Q.* Does it matter much whether a man makes a well this year or the next?—You must get him on the hop.

210. *Q.* You mean that if he does not get the money early enough in the season he will change his mind?—May be.

211. *Q.* You want it continued all through; you want a steady supply as in irrigation?—Yes.

212. *Q.* You say in the same paragraph "at present this duty is piled on the shoulders of the over-burdened Revenue Department, the underlings of which will naturally obstruct development." I can quite realise the difficulty, but how would you remedy it?—The Government should provide a special establishment and take up definite areas with a small separate establishment and work it till all possibilities are exhausted.

213. *Q.* There should be a permanent establishment to perambulate the country?—Yes. They would enquire as the men go about the country. You will have to entertain highly-paid men who could be trusted to make enquiries and do the distribution.

214. *Q.* What sort of men would you keep at the head of the establishment?—A man of the rank of Deputy Collector.

215. *Q.* Do you think a Collector would like a special duty Deputy Collector taking advances out of his hands?—He would not take it out of his hands. He will take it out of the hands of the taluk establishment.

216. *Q.* It would go through the hands of the Collector?—He would be a special Deputy Collector under the Collector. The Collector must be held responsible, supremely responsible for the whole thing. He will have a special man as he has for Forests.

217. *Q.* About black cotton soil, there is black cotton soil which can be irrigated profitably and that which cannot be?—Yes.

218. *Q.* Can you give us your definition of that which can be irrigated profitably? What are the conditions necessary for irrigating black cotton soil?—Black cotton soil is such an indefinite term.

219. *Q.* Can you make it more precise, more definite?—I don't see how you could define it. If your black cotton soil is heavy clay and you cannot drain it, it would not pay for irrigation.

220. *Q.* Are those the two conditions? Must they both exist, or, is either sufficient to prevent irrigation? Could you irrigate well-drained heavy clay?—If the clay is not too deep, we can irrigate it.

221. *Q.* That would necessarily mean that the drainage is not deep. If black cotton is shallow and clayey, can you irrigate?—Yes.

222. *Q.* On the other hand, most suitable black cotton soil is that which is not too heavy, not too deep and has good drainage?—Another point that has considerable influence on the question is the nature of the subsoil. Some of our black soil lies, as far as I have seen it, on gravel which is decomposed gneiss. As this is very full of alkalies, it requires to be irrigated carefully. That is the danger which you have in some cases and not in others.

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223. *Q.* But that condition being answered, other conditions are uniform?—Yes.

224. *Q.* What is the maximum depth of black soil that you could irrigate? More than how many feet?—If it is light enough, depth does not matter.

225. *Q.* If it is heavy?—I have not had any experience. It has been tried on stiff black cotton soil in Kurnool. There they won't touch it. Very often it is not more than 4 feet. There is no drainage there.

226. *Q.* You know of no cases in which real stiff black cotton soil, however shallow and however well drained, is irrigated profitably?—What I look upon as black cotton soil which I shall show you has been irrigated at Nandyal.

227. *Q.* Is it soil in which you can grow cotton without irrigation?—Yes. It cracks very widely.

228. *Q.* You know of no blacker cotton soil than that?—I cannot remember any particular tract.

229. *Q.* That is irrigated?—Only a small area. It has been irrigated for a long time.

230. *Q.* (*Mr. Muir-Mackenzie.*)—Where does the black cotton soil occur which is unirrigable or unsuitable besides that in Kurnool?—I have no experience of any other. We have not real experience to say that it is absolutely unsuitable for irrigation. It is unsuited in a degree.

231. *Q.* Nowhere?—It has not been tried; we have not had water on it.

232. *Q.* You would not commit yourself to the conclusion that it is nowhere totally unsuited for irrigation?—No. I would say that it is inadvisable to attempt it.

233. *Q.* You would not say that even the least well-drained places were totally unsuited for irrigation?—Down the Kurnool valley through which the Kurnool Canal runs, it would be inadvisable for a man to irrigate because of the want of drainage. It has been advised so.

234. *Q.* Still they do?—To a very small extent. It is only in special sites where there happen to be some special advantages for drainage.

235. *Q.* What I want to know is whether it would generally be in your opinion unwise for them to irrigate; in what tracts of the country does that disadvantage occur besides in Kurnool?—There is a large area in Bellary and Anantapur. In the southern and central part of Coimbatore and parts of Madura generally, although there is a fair amount of well-irrigation, I don't know if it is advisable to irrigate wholly or anything like generally. Again in the northern portion of Tinnevelly and Madura and then in Kistna upland taluks it is doubtful.

236. *Q.* One of the witnesses, an officer who sent in a memorandum, says there are 20,000 acres of black cotton soil under irrigation in Tinnevelly?—It may be black soil, sandy or loamy.

237. *Q.* You would doubt its being genuine black cotton soil?—Very much so. There are large areas under well-irrigation in moderate black cotton soil. But they are almost exceptional black cotton soil.

238. *Q.* What is the exceptional character?—Being loamy and sandy.

239. *Q.* I gather that garden cultivation is practised to a comparatively small extent under wells. Is that so over the Presidency generally?—Well-irrigation and garden cultivation are ordinarily used as synonymous terms.

240. *Q.* I mean the cultivation of valuable garden crops such as turmeric, sweet potatoes, and yams?—Yams are not much cultivated under wells; sweet potatoes considerably; turmeric not very largely but occasionally.

241. *Q.* And vegetables?—Vegetables are grown under wells.

242. *Q.* Are they generally second crop, with the grain as first crop?—They are one of the crops of the season.

243. *Q.* Would they be the only crop?—A portion of the land will be under garden crops and a portion under grain crops.

244. *Q.* Is a large area under the ordinary grain crop of the country?—Yes; everyone practically has one crop of grain. You may say that is practically the general rule.

245. *Q.* And used for its grain and not for its fodder?—No. The practice of growing fodder crops under wells is not known.

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246. *Q.* In any years of scarcity of which you have had experience, have you known a large number of *kachcha* wells dug hastily for the purpose of growing fodder?—Not for the purpose of growing fodder crops.

247. *Q.* For other purposes?—A certain number were sunk in the Chingleput district in 1891.

248. *Q.* Nowhere else?—I do not remember hearing or knowing of them. They are not at all common. The opportunity for them is not great.

249. *Q.* Is there no use attempting to increase the number of supplemental wells in a year of that sort?—They do it to some extent and in some districts considerably.

250. *Q.* In the Deccan?—I could not say for certain. I have no information on that point.

251. *Q.* Why; are the tanks too dry?—In a bad year the tanks are nearly so and in a year of severe drought are absolutely dry.

252. *Q.* From start to finish?—Yes.

253. *Q.* In a year of that sort if *kachcha* wells are dug under the *ayakat*, do you think they will be of no use?—No. They will have no water; not even *pakka* wells have.

254. *Q.* Do they also dry up?—In years of drought they dry up; supplementary wells are not generally used in years of drought.

255. *Q.* Was it not so in 1891?—I do not know; I was not out in that year, but presumably they were.

Mr. Nicholson stated that they ware used very largely where there was a small supply in the tank and sometimes even when there was no supply.

256. *Q.* In paragraph 6 of your note you say "as to substitution, it cannot be said that irrigation under works (a) and (b) leads to any such on a large scale, for paddy in itself is no more valuable than our dry grains." I don't quite understand; the price of paddy is generally higher than that of the grains?—The prices of paddy and ragi are generally identical.

257. *Q.* (*Mr. Ibbetson.*)—Is paddy unhusked rice?—Yes.

258. *Q.* (*Mr. Muir-Mackenzie.*)—I suppose that very few of these supplementary wells existed before the tanks were made?—Very improbable.

259. *Q.* Would you not be afraid if water was taken past supplementary wells after they had been made?—The fear would discourage rayats from digging such wells under these tanks?—I am alluding to Mr. Ibbetson's suggestion?—That suggestion pre-supposed that the whole custom of cultivation under the tanks was modified, that instead of the main crop being paddy the whole of the tank *ayakat*, as at present existing under the wells, was to be devoted to garden crops.

260. (*Mr. Muir-Mackenzie.*)—Do I understand your suggestion in that way?

(*Mr. Ibbetson.*)—In the case of paddy, the well is complementary but not supplementary. In the case of all others you can go on just as well without the tank.

261. (*Mr. Muir-Mackenzie.*)—Assuming that same conditions exist, do you not think that the digging of supplementary wells will be seriously discouraged?—I suppose the well existed before the question arose.

262. *Q.* You mean wells are already dug?—That is the suggestion put by Mr. Ibbetson. If you refuse to let water out of your tanks in order to make people dig wells, people will have sense to see that they can get water by digging. They would have generally a site to dig a well within a certain range. You need not fear the sense of the people on that point.

263. *Q.* The expenses of lifting water would be very serious in the case of a well?—Probably it would be very low lift; it might be only 4 or 5 feet.

264. *Q.* Even that would be expensive as compared with flow?—Yes. But it would be cheap compared with a 20 feet lift, which he might have if there was no tank.

265. *Q.* In paragraph 14 you say speaking of the Kurnool Cuddapah Canal "Government should then cause a detailed and careful investigation of the irrigational capacity of the country to be made on broad lines." What do you mean by "broad lines?" Do you mean protective lines?—I should say protective lines.

266. *Q.* As contrasted with merely financial and productive lines?—Not only that; the broadest principle is to utilise the water rather than try to make money.

267. *Q.* (*Mr. Muir-Mackenzie.*)—You say in paragraph 16 "that supplemental wells are very common in some parts, but in other parts are rarely seen in the wet lands and any explanation of the fact is difficult to find." Is not the explanation of the fact that the tanks above them have an insured supply?—No. I don't think so. In some parts of Chingleput you see supplemental wells, and in others you see none. You see the same in the Deccan. Some tanks have supplemental wells and some have not. Why it is so, I cannot say. I have not been able to work it out.

268. *Q.* I understood you to say that in the ceded districts only 3 per cent. of the area could be irrigated. Perhaps yours is a provisional figure?—It is a very provisional figure.

269. *Q.* Can you give us any idea as to what is the present area?—I don't know.' In Anantapur district there is 38,000 out of 1½ million cultivated.

270. *Q.* Would you despair of seeing the present area under the well-irrigation doubled?—In some parts of the ceded districts I don't think that there is any opening whatever, and in other places the area could be largely increased.

271. *Q.* I presume that the existing wells are restricted to those areas where the country is most suitable. You think that the number could not be doubled as a whole?—Probably it might very well be doubled. We have 185 thousand acres irrigated by wells in the Deccan district at present.

272. *Q.* You think that area could be doubled?—Yes. In a very large portion of Kurnool and Bellary and in some parts of Anantapur there is no opening, either the country is too high and rocky and you could not expect water and very often it is a question of distance from villages, a very important factor in the probable number of wells.

273. *Q.* You mean the rayat would not sink many?—No In some parts of Kurnool the probability of sinking wells is very large, and in others the reverse.

274. *Q.* I understand these varying conditions and difficulties, and what I want to know is whether there is any doubt whether the existing number of wells could be doubled?—It could be done.

275. *Q.* If it could be done how long would it take provided that money was freely advanced and a special establishment was provided and everything was given to get it done?—It depends on the number of men you could put on.

276. *Q.* What would you like to put on in each district? Would you like to see one establishment in each district?—I would not to begin with. I would like to see how it works. I would make the establishment of a Deputy Collector and a number of men, Revenue Inspectors and subordinates to carry out inspection. I would apportion them parts of the Kurnool district first and see how it would do. There an officer could double the number of wells. If a man knew the people, given the money, and given the establishment it would probably take three years; I do not see why it should not be done, if he has everything in his favour.

277. *Q.* Certainly he might manage it in double the time, say six years?—He ought to or be hanged.

278. *Q.* At any rate there is nothing extravagant in hoping that the number could be doubled with the aid of liberal advances, suitably advanced within twenty years?—Yes.

279. *Q.* I observe in the statistics you gave the area protected in all seasons, by which I understand the area protected in the worst season is under all sources of irrigation very much less than in ordinary seasons. That includes wells. Our statistics seem to show that the area protected by the wells, in the very bad season, in the first year of drought, runs very much above the area protected by wells in ordinary seasons; although in subsequent years of drought it sank on the whole owing to the exhaustion of wells, still it kept above the average of that protected in the ordinary seasons owing to the construction of more wells and other causes. Do you consider that these figures are thoroughly reliable that are given here?—I should not like to say that the figures are more than the best available estimate at the time that we put them together.

280. *Q.* For instance, we take Cuddapah 96,900 in ordinary years and 48,400, a half, for bad year. I should have expected to see 200,000 in a bad year?—A bad year, as a rule, is only the culminating point of a series of bad years. The year of drought is generally speaking preceded by a number of bad years. We very seldom find ourselves jumping into a year of drought suddenly.

281. *Q.* I am afraid that will hardly explain facts in Gujerat; 1899-1900 was unquestionably the culmination of a cycle of bad seasons, yet the area under wells enor-

mously increased, doubled I think?—My own experience of wells in a year of drought was the capacity of a well was very much reduced.

282. *Q*. I have not asked the well capacity. But I have asked about the area under wells. Can't you get a pit dug with a stage môt which will last for a year. That was done in Ahmadnagar in 1897?—That could be done in the coast districts.

283. *Q*. Not in inland districts?—You have not got water; you could not get down to it. You surprise me. In our inland districts such as Sholapore they make such efforts to increase the area. The area acertainly does not diminish. The total area was very considerably increased under pressure of famine.

(*Mr. Ibbetson.*)—I never heard such a thing in the Punjab as *kachcha* wells being dug in a season of drought.

284. *Q*. (*Mr. Muir-Mackenzie.*)—You do not think if money had been liberally advanced in time; you could have obtained such an increase in 1891?—In 1891 at the starting, money was given as freely and as largely as could be; but the establishment was insufficient and a large number of wells was started in different places and they were all *pakka* wells.

285. *Q*. They would not have been in time to have done anything in that year?—Some of them might have done. What they did in Coimbatore was to deepen the old ones and make them efficient and therefore they kept up the area irrigated.

286. *Q*. I have no doubt that accounts for increase in area?—And the same happened in Kurnool in the year 1892.

287. *Q*. Nevertheless in Coimbatore the area irrigated under wells in bad years is put very much less than in ordinary years?—At the time that atlas was compiled the information available as regards wells was very limited.

288. *Q*. You would surely have good information about 1891-92?—And all that was available in 1892 was published in 1895.

289. *Q*. I am sorry to worry you, but it is a very important point why the area under wells should go down?

(*Mr. Ibbetson.*)—All our experience in the mofussil coincides with Mr. Benson's experience.

[At this stage the President read a letter from Colonel Grant of Mysore.]

(*Mr. Nicholson.*)—I do not think *kachcha* wells are possible in famine districts.

290. *Q*. (*Mr. Muir-Mackenzie.*)—Do you think money has been advanced for wells in time in years of drought to get them to dig wells in time for use in that year?—I do not think, as a rule, that money was given nearly soon enough to enable them to get any direct return that year.

291. *Q*. How soon should money go out?—You should begin 20 years beforehand.

292. *Q* I mean for the multiplication of *kachcha* wells in a year of drought?—As far as I remember, there is a ruling on that point that it is not allowed; a special ruling was made in regard to Pouneri taluk and we did not give money. As a rule, we do not give money for *kachcha* wells.

293. *Q*. Would you not advocate money being given liberally in coast taluks?—I would. I think I did advocate it ten years ago. I do not remember what happened.

294. *Q*. Is it possible to advance money early enough in Deccan taluks for wells to be made in time?—Not at all, unless you are going to have drought for two years. In a year of drought the water level would have gone down very low.

295. *Q*. Therefore the only thing to do is to take care to get it done beforehand in the previous years?—Get the money beforehand.

296. *Q*. Can you give me at all a correct idea as to the increase of wells in the last ten years in any of the districts?—No.

297. *Q*. Are there no statistics or settlement reports?—I do not think there are any figures which can be safely relied upon on that point except the actual number constructed by loans which we know.

298. *Q*. (*Mr. Ibbetson.*)—One witness, who spoke with some authority, told us sometime ago, that however favourable the conditions were for irrigation, and however much you may irrigate from wells or small tanks, he would very much hesitate to introduce into black cotton soil extensive irrigation, such as you get from a big canal, for fear of water-logging on account of the retentive nature of the soil. How far would you share in that apprehension?—I do not know exactly how water-logging would occur unless water ran over the land, until you send it down distributaries. You could not do it, until you puddled it.

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299. *Q*. His view is this: black cotton soil even when most suitable for irrigation, where conditions are most favourable, cannot safely be irrigated wholesale; that is to say, large areas together, such as you get on a big canal, because you would get water-logging?—If you get black soil suitably drained, there is no difficulty. I don't think we need be afraid, because we have done it in Kistna. But that is not the black soil of the Deccan. If we have black soil that is sufficiently mixed and sufficiently drained, it would obviate danger; but if you have a retentive soil, I would agree with what has been said. It is a dangerous thing if you have retentive soil. Unless everybody practically changes their system of irrigation it would not be possible.

300. *Q*. Unless water is used with the strictest economy?—Yes.

301. *Q*. You only apprehend that danger in really stiff black cotton soil?—Yes, and also where there is difficulty about drainage.

302. *Q*. Suppose drainage is good, even then do you think that stiff black cotton soil could be irrigated wholesale without danger?—I think it could be, but I don't think it should be. The evidence of 1876-77 under the Kurnool Canal shows it could be done, profitably done; they had 10,000 acres. There must have been very large blocks under the canal. I do not know what they were.

303. *Q*. The irrigation in the single year of 1897 would hardly be within my question I mean regular irrigation?—It depends more upon what the crop is than anything else.

304. *Q*. Say cane and garden crops?—You must have continuous supply of water for them. I don't think cane and garden crops would flourish freely on stiff clayey soil. You do not find much of them.

305. *Q*. Have you heard any suggestion that after that extensive irrigation under the Kurnool Canal in 1877 the next year's crop suffered on account of the soil being sour?—I was not there soon enough afterwards; I know they used to say down below that the first time that land was irrigated and gave a poor return it was due to water.

306. *Q*. Do you believe that the crop would be deteriorated year after year by irrigation?—Not if you treat it properly. Water is a stimulant; if you have a heavier crop, you will have less left behind. I don't think anything serious would happen in any way.

307. *Q* (*Mr. Rajaratna Mudaliar.*)—You said by extension of second crop you would get more revenue than you would by extending the first-crop cultivation?—You will get more revenue with less cost.

308. *Q*. You would get double the revenue. Would not that cover the increased cost?—I doubt it, because our present works were made in the most favourable situations. If you want to extend the first crop you must go to a greater distance. That is the engineering point of view.

309. *Q*. In Madura there was some complaint on the part of rayats that sufficient water was not available for second crop. They wanted irrigation for ten months and the Executive Engineer maintained that they could grow two crops in nine months. What is your experience?—They could grow two crops in eight months.

310. *Q*. I don't mean by change of system, but assuming they don't change the system?—If you have a change of water-supply, there must be a change of system to fit it.

311. *Q*. Assuming they continue the present system, do you think nine months' supply would be sufficient?—They have not made the system to fit nine months. As far as I understand it, their present arrangement would not fit the present system, because they would not arrange the system to fit nine months. If they get nine months' water they must fit the system to it. It is quite long enough.

312. *Q*. How could they fit it?—You have three months' crop and a five or four months' crop; you could get those two crops into nine months, with an interval of a month.

313. *Q*. About 40 days are required for seedlings?—They could grow them with wells

314 *Q*. There are no wells there?—They could sink them. You have got a three months' crop and a five months' crop and you have one month's interval.

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315. *Q.* There must be time for preparing the land and preparing the seeds?—How long would that take?

316. *Q.* That is what you must say?—You would grow first crop seedlings and have them ready when you get water.

317. *Q.* That assumes that there is water?—Water is available everywhere in wells. They might have to lift it for seed-beds which will only be for a small area. It is only for a certain proportion of the area that they want this first crop planted so soon. Tinnevelly rayat is better than Madura people. He sows seeds dry. He very often ploughs the area and sows the seed broadcast before water comes down the river. Generally speaking, in that country, you get a very large amount of *kodai* or hot-weather rain and there ought to be water in many of the tanks. There is a considerable area of land cropped with *kodai* in the district. That is done when rain falls in April and May. I don't think there is anything impossible in growing two crops as far as they have got water for it. They may want possibly in some cases to substitute four months' paddy for five months' paddy.

318. *Q.* (*Mr. Muir-Mackenzie.*)—I would ask you what is special condition or conditions in Coimbatore which have enabled such a large area being put under wells. Is it the people or is it the rock?—I think it is a question of many things acting together. First of all, they have a bad set of conditions to deal with. That is the rainfall.

319. *Q.* So have they in the Deccan?—They have; but, on the other hand, the distribution of the rainfall is different. It lends encouragement. You have got protection. Considerable rainfall comes in April and May and then you have three months' drought and then the rains again. You have the first two months' rainfall with little water in wells. With *kodai* rainfall, you get a lot of water spread over a much larger area effectively. Again at a later season you get a second crop after the second rains. From the same land you can get two crops certainly over the greater part of it. Well-irrigation there is very effective.

320. *Q.* Do I understand you that with two sets of rain they get full wells again?—That helps them out over a larger area and also keeps up the supply. It is only when the rainfall is so late that they have to depend very largely on the under-ground water that people feel the difficulty very considerably.

321. *Q.* The second reason I believe is that they are exceptionally energetic and enterprising?—There is no doubt about it. They are hardworking. Cultivation is very good under the wells. I think that the fact that the country is enclosed is an encouragement to wells indirectly. Crops are all protected naturally.

322. *Q.* You don't think it is general for people to make hedges to protect valuable crops. It is one of the puzzles that is open to any man's investigation?—I have not quite satisfied myself on that point.

323. *Q.* Is the geological formation specially favourable?—I think it is so; the rock holds much water. There is great deal more water at corresponding depths than there is in the Deccan districts.

324. *Q.* The whole well is sunk within the rock in Coimbatore?—All the bottom portion will be blasted out.

325. *Q.* After 30 or 40 feet?—It varies very much. In some places we will be able to get crowbar work up to 10 feet or so. After that it is more or less blasting. Deepening must have gone on for generations.

326. *Q.* They have been quarrying a bit more every year?—Yes.

327. *Q.* (*The President.*)—The spring levels are pretty deep?—It runs down in some places to 35 feet. There is a lift of 38 feet in wells in Palladam.

328. *Q.* (*Mr. Muir-Mackenzie.*)—Cuddapah is another district where there are great many wells?—In portions of it.

329. *Q.* The number of wells relatively is large as compared with other districts. What is the favourable circumstance there?—In the sub-division you will find wells in the valleys. The country is very broken; you will find wells along natural drainages and a number of little tanks hold up water not only for wells in the *ayakat*, but they raise the water level generally. Then in the eastern taluks you have got two natural hollows, and the rocks dip into the hollow. Water is found in the centre of the valley. In these sandstones you can find water everywhere.

330. *Q.* There the facility is in the formation of the country?—In the eastern parts of Cuddapah the formation of the country offers facilities for wells.

331. *Q.* Whereas it is chiefly due to geological formation in sub-division taluks only, but there it is due also to the formation of the tanks?—Yes, they help it out. They keep the water from running away.

332. *Q.* There is one other question in connection with the wells? Would you advocate the keeping on any of the tanks, for instance, Periyar? Would you advocate the keeping of water so as to give a limited supply throughout the whole year with the object of encouraging sugarcane and such like crops? I may explain that in most of our Bombay works there is water for almost perennial irrigation, *viz.*, that is given throughout the 12 months in the year. We could not grow cane without that?—I doubt whether it would be good policy.

333. *Q.* Why not?—Because your losses on the amount of water that you would have to provide to supply small areas during the dry season would be very large. It is a difficult thing to speculate about.

334. *Q.* (*Mr. Nicholson.*)—With reference to Mr. Ibbetson's question as to the result of limiting the use of water extending thereby the area to which water so saved would be extended; as a matter of fact, is there in many cases scope for the extension outside the *ayakat* of the tank owing to the lie of the land or other reason?—In high levels if you get full tank you can do it. If you get a partially filled tank you would probably require all the water there is for the whole *ayakat*.

335. *Q.* So that the answer does not affect the great number of tanks which will come under the term precarious?—I have got a little bit mixed.

336. *Q.* It is important because, as I understand, many of the tanks have a small area in the *ayakat* which cannot be irrigated in the present circumstance owing to the lie of the land?—I do not think that it is an area which in average years has been irrigated previously. I do not know whether it necessarily follows that it is the only area commanded. In the case of a good many tanks, in the flatter country especially, other areas could be commanded. Of course in narrow valleys you could not do it.

337. *Q.* And those narrow valleys are in the precarious districts of Anantapur and Cuddapah?—Yes.

338. *Q.* Is it not an academic question, seeing that it would practically amount to a breach of faith to give water to dry lands instead of the wet?—As the question was put to me, it was entirely a question of speculation.

339. *Q.* If you had a tank, with a certain area below it entirely irrigated by wells growing garden crops, would there be any difficulty in taking water beyond it. Have you ever met with such conditions?—I have never met with such conditions.

340. *Q.* You said that funds were stopped when loans were half issued in 1892 owing to want of funds. How did the shortness of funds arise? How was it that Government found itself unable to issue a second instalment?—The original grant for loans was, I believe, 5 lakhs. As a means of relief, Collectors were encouraged to advance as much money as possible for land improvement. Advances promised ran up to something like 29 lakhs and when a further grant was asked for from the Government of India there were all sorts of questions raised, and until full explanations were given they said no further sums were to be advanced.

341. *Q.* I understand that the Government of India found itself unable to advance funds at that particular period?—They declined to authorise the further issue of money.

342. *Q.* Did the Collectors go on making advances knowing that they had only 5 lakhs?—The Local Government asked Collectors to go on with advances seeing that it was a very useful thing to encourage.

343. *Q.* One other question which has arisen especially with regard to the second crop; many of the witnesses have stated that the real difficulty is that owing to want of manure land deteriorates if second crop is raised. Have you any suggestions to offer which will get over the difficulty or is it a real difficulty?—To take two crops out of land, you naturally want more manure. Under the most favourable conditions that we have for second crop, the manure question is not a pressing one.

344. *Q.* Why?—Because the supply of silt from the rivers is most important.

345. *Q.* Take the Periyar lands with reference to which the question largely arose?—That does not refer to second crops.

346. *Q.* Would it be possible to encourage the growth of second crop if manure was more easily obtainable?—I do not think that the manure difficulty would remain a practical difficulty. People would get over it as they have in Tinnevelly. They go 30 or 40 miles. I know people march 30 miles from Tenkasi to bring leaf manure. Similarly, in the Periyar area, when things get into working order, people will get over the difficulty themselves.

347. *Q.* Is it not a fact that owing to want of manure they have to send carts, 30 or 40 miles, for instance, to bring the manure that is very necessary for cultivation?—That is to say, they utilise a portion of the country where it is easier to grow manure for the benefit of the country where manure can be most advantageously used.

348. *Q.* Can you suggest any method by which manure can be increased and yet cheapened?—On the land where crops are grown, manure can be grown. Granting water free to encourage it would be the most effective means of increasing it.

349. *Q.* Suppose free grant of water is not allowed, would there be any possibility of getting round it in any other way?—I believe there is a very large area of waste land which is quite within easy reach of the Periyar area which can be easily utilised by the people at a very low cost.

350. *Q.* Would you extend the standing order I was quoting and make plantation for manuring purposes free?—Yes, for a reasonable period. You would do better to utilize land for growing something than let it lie unused.

351. *Q.* With reference to the development of wells, I think you are in favour of a somewhat different principle of repayment of the loans advanced by Government; would you explain it?—I am inclined to think that the whole thing should be made into an annuity fixed upon the land.

352. *Q.* In what way would it differ from the present system?—Land is simply a security. If my proposal is adopted, the charge would become a portion of the land. assessment.

353. *Q.* By virtue of the annuity the loan would be paid off insensibly. You would like this in preference to its being subsequently paid?—Yes.

354. *Q.* Do you mean you would not give option to the rayat to pay off his loan in a shorter period?—No. I would not prevent men from clearing up and paying the whole amount.

355. *Q.* Will you ordinarily allow ten years?—Twenty-five years at 6½ per cent.

356. *Q.* (*Mr Muir-Mackenzie.*)—What period of annuity will you fix?—I would fix it at 6¼ per cent. It is a simple thing.

357. *Q.* Why don't you fix a longer period so that you may have a better chance of getting down to the poorer man. Don't you think the rayat would be tempted by smaller payments which would result if you increase the period?—If you get down to the smallest men they would prefer long payments. But a large number would like to get rid of it. Personally I would do so if I took a loan.

358. *Q.* If you introduce long payment will there not be better chance of getting at smaller men?—It depends upon what you are prepared to accept as security. According to the interpretation of security at present, you cannot get down to smaller men.

359. *Q.* It is impossible to get down to them at all?—As far as I read the rules as at present interpreted.

360. *Q.* How are they at present interpreted?—Land must be security, but not improvements made. You must take land without improvement.

361. *Q.* (*Mr. Nicholson.*)—Would you take the plan mentioned by one or two witnesses of advances *pari passu* with the work?—That seems to be the only common-sense view and when you have proper control of the advances, but for that the present staff have neither the time nor the inclination.

362. *Q.* So that the method connotes proper staff and good establishment?—Yes.

Mr. C. Benson.

363. *Q.* One witness has suggested that small oil-engines should be provided on deep wells in preference to individual wells with bullocks. What objection do you find to that?—In the first place, it has got to be proved that you will get any more water at the deep level. In the second place, the man has got the cattle and he must keep them; he is producing his fodder and it is a useful way of employing them at the môt, when he cannot employ them on the fields.

364. *Q.* Witnesses have also said that good dry soils produced as much in normal years as irrigated soils. What is your experience?—If you get a first-class irrigated land and a first-class unirrigated land, the irrigated land would yield considerably more as a rule.

365. *Q.* I used the word good land to mean land in proper manurial conditions?—I doubt whether you will find any land that is better than the best land in Tanjore. I do not know whether you will get a better yield.

366. *Q.* Taking it in another way you say that 10 per cent. of the land in the Anantapur district is irrigated in ordinary years. It is possible to add 3 or 4 or even 10 per cent. of further irrigation. It means that 80 per cent. of the land under cultivation can never be irrigated?—Yes.

367. *Q.* Is there any method of protection which you can suggest other than that of direct irrigation?—Every bit of manure that you get into the land and a more thorough tilling of the soil makes the land very much more secure.

368. *Q.* Would it very much further secure the crops in the worst areas?—I doubt whether on the high ground where the dry land is very near the rock it can protect the crops.

369. *Q.* Taking the Presidency generally?—Taking the northern portion of Anantapur and the greater portion of the eastern part of Bellary, I have not got the slightest doubt that the crops in that area might be made very much more secure.

370. *Q.* (*Mr. Muir-Mackenzie.*)—By deep tillage?—Yes. I was up in Adoni in December 1896 and cotton crops on land that had been deeply tilled were looking very well alongside of the crops on the lands that had been ordinarily tilled, which were all gone or going very fast.

371. *Q.* (*The President.*)—Is the rayat taking up the practice fast?—It is the practice in that part of the country to till a certain proportion of the land deeply and their turn comes very slowly. It is chiefly done to get out the *nath* grass. I judge from the results that it has a very good effect.

372. *Q.* (*Mr. Muir-Mackenzie*).—It is not the getting out of the grass that made it better?—No. The cotton on the field alongside had gone. My attention was called to it by the Cotton Agent there, who wanted me to come and see it.

373. *Q.* (*Mr. Nicholson.*)—Have you not often seen in seasons of drought in Tinnevelly and other places that fields, side by side, had good crops and bad crops?—Yes.

374. *Q.* For instance, putting the most crucial case—that case you know—you remember the famine of 1877?—I remember the season of 1876.

375. *Q.* The Saidapet farm consists of rather sandy soil?—All sand.

376. *Q.* Did you not get a cholam crop with a certain amount of grain and a large amount of fodder with 1½ inch of rainfall on deeply tilled soil?—Yes. That is on record. We had a crop of sorghum of 1,500 pounds to the acre. I don't say in that case it was due to manure.

377. *Q.* (*Mr. Muir-Mackenzie*)—Had you abundant manure?—It is a long way back to remember what we did in the year 1876. We did not do anything extraordinary. I remember the crops. We had 5,000 pounds of straw.

378. *Q.* What was the area; was it a fairly large area of 10 or 20 acres?

(*Mr. Nicholson.*)—I think it was about 3 acres.

(*Witness.*)—The next one was between 3 and 4 acres, where we had a small yield of grain and about 3,500 pounds fodder.

379. *Q.* (*Mr. Nicholson.*)—Alongside all that, on shallow tilled ground land there was next to no grain and hardly any fodder?—Yes. Its only importance was as a relative outturn.

Mr. R. N. H. Reid, Executive Engineer on special duty, Divi Pumping Project, Kistna.

(Rajahmundry, 17th February 1902.)

Answers to Questions for Public Works officers.

Mr. R. N. H. Reid

Qs. 2 & 3. I believe that the construction of a large storage reservoir on the Kistna is feasible and would permit of the expansion of the *ayakat* now under the anicut to one million acres of first crop land and two lakhs of second crop, besides enabling the canals to be kept open for eleven months in the year. It would also enable a greatly increased discharge to be sent down the Kurnool-Cuddapah Canal, or similar new cut to be made, and so greatly increase the area irrigated from the Penner river in Nellore district. I have gone fully into the matter in my note to Mr. H. E. Clerk, dated 28th September 1901. I am just leaving for the Palnad to obtain further information as to the nature of the river-bed.

I do not see how a similar reservoir on the Godavari can be required for the irrigation in this presidency, as there is more than sufficient water in the river for the gross area commanded by the anicut at Dowlaishweram.

I believe that at least two, and possibly more, new major works are possible by using large pumping machinery for pumping water from the Kistna and Godavari rivers. The site for the former is below the anicut and about 20 miles from the sea, the area (50,000 acres) to be supplied being in Divi Island. Complete plants and estimates amounting to 12 lakhs of rupees are nearly ready for this project.

The site on the Godavari is on the right bank about 15 miles above the anicut. Preliminary levels are now being taken and tend to show that an area of nearly one lakh of acres can be so supplied on the north of the Godavari-Ellore Canal. Either wet or dry lands to be irrigated and the supply to be maintained throughout the year. Levels will shortly be taken to ascertain the feasibility of a similar though smaller project on the left bank of the Godavari,

A pumping project for about 50,000 acres is also feasible on the right bank of the Kistna above the anicut and probably also on the left, but owing to the shortness of the supply in the river these must await the construction of the reservoir.

Q. 5. I believe the work now being done by the six Tank Restoration Scheme parties in the way of examining in detail each river basin and recording the hydraulic features in the form of memoirs and maps to be invaluable, but the progress is slow, and I would at once double the number of parties, the cost of which is not great. The real expenditure of the Tank Restoration Scheme is not on these survey parties but in the execution of the tank repair estimates which they prepare and which are carried out by the regular divisional staff. This work consists in putting in adequate surplus escapes which is very necessary though I think the length usually allowed is more than is strictly required. No escape can be made at a reasonable cost to withstand a cyclonic outburst which may not occur once in 50 years. At present I think the value of the coefficient in the formula $D=CM^{\frac{3}{4}}$ is taken too high. The main item of expenditure is in making up the *bunds*, a great part of which is absolutely unremunerative. It is obvious that a newly raised *bund* will lose much more by attrition in one monsoon than will one which has been through several rainy seasons, and I think it is economical to allow a *bund* to go as long as is reasonably safe without remaking and then make it up to ample section to last for a number of years. All tanks under 200 acres are supposed to come under *kudi-maramat* repairs, and it is probable that something would be done by the villagers if they knew that their efforts alone could save their tank from destruction. At present the *bunds* of all tanks with few exceptions are made up under the provisions of the Tank Restoration Scheme estimates. In very few instances can it be shown that the Tank Restoration Scheme repairs will increase the tank *ayakat* by so much as a single acre.

In 1898 the practice in the Tank Restoration Scheme office of preparing detailed books of plates for each minor basin was given up and the men so employed were put on to check the large accumulation of estimates that were waiting to get through the office. Before this it was not unusual for an estimate to be sanctioned and issued for execution some two or three years after the levels of the *bund* had been taken. A further delay of a year at least in the Division office in carrying out the work, due to lack of funds, was not uncommon, so that the work was actually completed some four or more years after the levels of the *bund* were taken and the earthwork quantities by this time were practically worthless. Even now at least two years must, as a rule, elapse between the levelling and the repairing of the *bund*.

I would therefore stop altogether the preparation of estimates and confine the Tank Restoration Scheme parties to the mapping and grouping of tanks and collection of all hydraulic details as is now done and published in the memoirs, at the same time doubling the number of the parties. When any tank is really in need of repairs the information supplied by the memoirs will enable either the Public Works Department or the Revenue authorities to prepare the estimate if merely supplied with levels of the *bund*.

The Tank Restoration Scheme if properly worked would provide a valuable training ground for subordinates for the Public Works Department, but the prospects are poor and the work monotonous and candidates for employment only enter to gain some experience and at once commence looking out for something better. If a definite number of upper subordinates were taken every year from the Tank Restoration Scheme, a better class of men would enter and only men who had shown themselves to be intelligent and industrious would be admitted to the Public Works Department; a two or three years' probation would be quite sufficient. Men of experience are not required as sub-overseers in the Tank Restoration Scheme, but men who are active and quick levellers. Senior men will not stay if they can possibly help it. I don't think that there is any prospect of increasing to any material extent the number of these minor tanks. They are nearly all of native origin and the local cultivators are keenly alive to the advantages they confer on their lands. If any group of rayats see a chance of storing water, however little, they at once combine and throw up a *bund* for the purpose. They require no aid from Government for this purpose.

The funds now expended on tank repairs I would devote in great part to a detailed investigation of every district in the presidency and to the provision on all tanks of self-acting weirs. The Tank Restoration Scheme investigation is not sufficient in itself. It is confined to existing works, and the officers in charge of the parties are not competent to make the detailed investigations that should be made. This should be done by an Executive Engineer making use of the information already collected by the Tank Restoration Scheme and should be exhaustively carried out for each district not omitting the openings for use of pumping machinery whether on a large or a small scale.

I think it would be possible to effect a great improvement at a very moderate expenditure by providing all minor tanks with self-acting weirs. The idea is no new one, but nothing has so far been done. My predecessor in the Tank Restoration Scheme wished to adopt an iron falling shutter similar to those on the Cheyar anicut in North Arcot. These shutters are efficient but are heavy and very expensive and cannot be repaired locally.

There is in one of the back volumes of the minutes of Proceedings of the Institution of Civil Engineers (Vol. LX, I think) a cut showing a falling shutter which was many years in use on one of the Cheshire canals and was said to have proved quite successful, and which I think would prove suitable for general adoption on the minor tanks and of which a trial should be made. The iron shutters on the Cheyar anicut are only automatic in the sense of *falling* when the water reaches a certain level. They have to be raised by hand. The one I refer to is absolutely automatic both in falling and rising and is so simple that it could be made and repaired by any village carpenter. A board 1¼ inches thick and of a width to correspond to the difference in level between full tank level and maximum water level, say, one or one-and-a-half feet, is placed on edge with its upper edge at maximum water level and its lower one at full tank level. It is hinged at the outer edge so as to fall away from the tank when depressed by the water pressure. The plank is, say, 10 or 15 feet long, and to the upper edge is attached a lever arm, or two arms—one at each end pointing in towards the tank and carrying an iron weight at its extremity. The lever arm is inclined at such an angle to the horizon as to cause the centre of gravity of the whole to fall outside the base of the plank when depressed and tend to make it rise. When the tank is empty the counterbalance weight always keeps the plank upright and when the tank is rising above F.T.L. the action of the weight is sufficient to maintain the upright position of the plank until the water reaches the upper edge or M.W.L. when the pressure of the water overturns the plank and permits the weir to discharge effectively between the levels of F.T.L and M.W.L. As long as the water remains above M.W.L. the plank remains depressed, but is raised at once by the action of the counterweight as soon as the water falls below that level.

Experimental adjustment is necessary to determine the correct position of the lever arm and the weight of the counterbalance. This could be easily done once for all for varying heights of M.W.L. above F.T.L.

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The desired length of weir would be made up of a succession of these planks, each end of which would, when raised, fit against a recess on an ordinary *calingulah* stone, the top of which would be at maximum water level.

The only objection I have ever heard urged against this automatic weir is that floating trees might break off the arms. This contingency is not probable and even if the arm were broken, the plank would fall and so fly to safety.

The plank could be made of the most ordinary jungle wood and the lever arm and counterweight made by the village blacksmith, while the hinges could be cheaply purchased. The cost of such an automatic weir would not be more than Rs. 2 a foot.

As the great majority of tanks are very shallow, the increase of storage afforded between F.T.L. and M.W.L. would be very great, probably not less than 20 per cent.

With 35,000 major and minor tanks irrigating about 2,000,000 acres this means an increased *ayakat* of about 400,000 acres.

The three lakhs now spent annually on raising the *bunds* would, in a few years, provide every tank with an automatic weir.

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1. *Q.* (*The President.*)—You are on special duty I understand just now ?—Yes

2. *Q.* What is your duty? -I have been for one and-a-half years investigating the Divi pumping project on the Kistna.

3. *Q.* You have found time for other things too ?—Yes.

4. *Q.* As regards the Divi pumping project, what acreage is it intended to supply ?—The total area is 80,000 acres ; I prepared estimates for 50,000, because that amount can be supplied without introducing drainage works.

5. *Q.* What pumps are proposed ?—Forty-two inches centrifugal pumps by Gwynne.

6. *Q.* What is the height to which water is to be lifted ?—The maximum lift is 15 to 16 feet ; the average is only 9 feet.

7. *Q.* The Divi Island must stand at a considerable height above the sea-level ?—Yes.

(The witness explained on map that Divi is the true delta of the Kistna river. Before the idea of supplying it by pumping was started, it was proposed to connect the island with the Kistna delta system by means of an aqueduct. This idea was however given up, because there are about 1,000,000 acres on the main land which are commanded by the anicut and only about 700,000 can be supplied without a reservoir. It was considered that these latter lands should be brought under cultivation before attempting to make an expensive aqueduct to Divi.)

8. *Q.* Are there any pumps there yet ?—There are three small experimental pumps—7″, 8″ and 10″; and 830 acres were irrigated to see how long the water would remain fresh.

9. *Q.* Have any native landowners taken to pumps ?—Not in the Divi Island ; in the Colair lake they pump with steam power for irrigation.

10. *Q.* Have you any experience of pumping in any other part ? -No ; I really do not know much about the pumps themselves.

11. *Q.* You say that 15 feet lift is required to command the highest part of the island ?—No ; it is to command the whole area at the lowest state of the tide. This is an extreme state of affairs. Twelve to fourteen feet will generally be a maximum.

12. *Q.* Would you deliberately let the water pass the anicut for the sake of pumping ?—No ; it affects the delta in no way whatever.

13. *Q.* You say in your note talking of the Tank Restoration Scheme—" In very few instances can it be shown that the Tank Restoration Scheme repairs will increase the tank *ayakat* by so much as a single acre." For want of repairs, I presume, the *ayakats* are getting smaller ?—Well, I don't know if one could say that ; the *bunds* were down ; they are liable to breach.

14. *Q.* The Tank Restoration Scheme would be rather an insurance against breaches ?—Quite so; it safeguards the revenue we have rather than increases it.

15. *Q.* You say " I would therefore stop altogether the preparation of estimates and confine the Tank Restoration Scheme parties to the mapping and grouping of tanks"?—Yes, I should say in that connection ;I mean, as long as funds are not available for investigation in other districts.

16. *Q.* I suppose, since you wrote this note, you have made surveys of this great reservoir you speak of on the Kistna ?—Yes, quite lately, or rather perhaps I should say I had some levels taken for the delta.

17. *Q.* You have come to the conclusion that there would be a storage of 90,000 million cubic feet ?—That is only approximate. It cannot possibly be under 70,000 to 80,000.

18. *Q.* The under-sluices would pass the whole of the Kistna flood ?—Yes (explained on map.)

19. *Q.* You propose to supplement the Bezwada anicut also ; what is the discharge of the upper canal ?—I have put it at 35,000 millions, of which 20,000 is given to the delta for second crop and navigation.

20. *Q* Why ?—The first idea of the reservoir was to grow 2 lakhs of acres of second crop in the delta and maintain navigation for ten and-a-half months in the year.

21. *Q.* How long is it now ?—About nine or nine and-a-half ; it is supposed to be only nine ; there would be 15,000 millions left for 3 lakhs of acres.

22. *Q.* One function of your under-sluices would be to clear the silt ?—Yes.

23. *Q.* It is an extremely important work. What is the discharge of the canal ?—3,500 cusecs. It passes through a rock cutting for 30 to 40 miles and afterwards into open country. The greatest depth of cutting would be 35 feet for half a mile (explained on map.)

24. *Q.* (*Mr. Higham.*)—Do you suppose that you would get 2 lakhs of acres of second crop ?—Yes.

25. *Q.* If you had water for it ? -Yes.

26. *Q.* That would be the maximum ?—Yes.

27. *Q.* Do you think you would get one-fifth the first crop ?—I took one-fifth the proportion in Godavari as a guide.

28. *Q.* The proportion in Godavari is much higher than it is elsewhere ?—No, I think the proportion increases to the south ; Tanjore is only one-tenth. On the Palar I think the proportion is greater than on the Godavari.

29. *Q.* Do you think it would be 200,000 acres ?—Many say no ; it is difficult to say.

30. *Q.* It has often been said that the soil here is not rich enough for two crops ?—Yes.

31. *Q.* There is a great deal of doubt about the matter ?—Yes, hitherto they have not had a chance of growing a second crop.

32. *Q.* Suppose you don't want this water for a second crop, could you spare any for the Nizam's land ?—I don't know if there is suitable land ; the soil may be too rocky. The Munniyeru would require an expensive aqueduct to cross. In connection with this I propose, instead of money

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compensation for land submerged, to give so many feet per second of water.

33. *Q.* How high up is the reservoir?—Ninety miles above the Bezwada anicut.

34. *Q.* You mentioned a proposal to pump on the right bank of the Godavari?—Yes.

35. *Q.* Has it not been proposed to command that tract by means of the anicut?—I don't know. I have heard of a proposal for a reservoir.

36. *Q.* That would be a bigger thing than pumping?—If you are to protect dry crops, no doubt it would pay to do it with pumps. At the site I propose one could irrigate about one lakh of acres.

37. *Q.* You only propose pump irrigation for protecting dry crops?—Not necessarily. If you grow dry crops you can send water further. The rayats always grow wet crops in preference to dry. If a charge of 20 per cent. water-cess was put on, you could induce them to protect a larger area of dry crops.

38. *Q.* If the wet assessment was higher?—If a prohibitive assessment was put on paddy.

39. *Q.* In the case of the bank canal I think the rayats protested against water being brought to their lands because they did not want them to be brought under wet cultivation?—Yes.

40. *Q.* Why should not the lands you propose to irrigate be served by an anicut?—I don't know what height the anicut would command. I think these pumps can lift water remuneratively up to 50 or 60 feet.

41. *Q.* What is the area you propose to command on the Divi Islands?—The total area is 80,000 acres; I have prepared estimates for 50,000.

42. *Q.* Wet crops?—Yes.

43. *Q.* They must be wet?—There is no reason for making them dry.

44. *Q.* You have a preference for wet cultivation?—Lands are not very well drained in the Divi Island.

45. *Q.* During what period will your pumping take place?—As soon as the river comes down in flood from the middle of June to about the end of November.

46. *Q.* As soon as the floods cease your water will be brackish; the sea water then comes up?—The pumping station is 27 miles from the sea. It takes some time to get to it.

47. *Q.* You would only pump when there are fairly strong floods coming down?—The floods go on without ceasing for three or four months; after they cease you have an interval of twenty-five days before the sea water comes in and contaminates the still water.

48. *Q.* In regard to the Tank Restoration Scheme, you propose to leave off making up of tank *bunds*?—It was only on the supposition that money was not forthcoming.

49. *Q.* Do you think that where the restoration party has proposed estimates for making up tanks it is unnecessary to make them up?—I mean that every tank is levelled and an estimate is prepared for it whatever its condition may be; in certain cases the *bunds* would stand for four or five years without further repairs. I think it is economical to let the *bunds* wear down as far as possible consistently with safety.

50 *Q.* They have proposed re-sluicing in many cases?—Yes, and surplus escapes.

51. *Q.* Would you proceed with them at once?—The sluices are generally adequate; new plugs and shutters are required; that does not cost much.

52 *Q.* What about waste weirs?—I would put them in too.

53. *Q.* You propose falling shutters? I was on the Tank Restoration for two-and-a-half years, and I remember many tanks in which the foreshore was pure waste land. A falling shutter would enable 1½ or 2 feet of water to be held up.

54. *Q.* If you held water up would that not submerge valuable land?—Yes, in many cases; but in a great many it would not. In Nellore there are many tanks in waste lands; it is in these cases that you could hold up to a considerable height without submersion.

55. *Q.* Where lands are cultivated, I suppose it is now assumed that water will stand at maximum water-level for only a few days?—Yes.

56. *Q.* If it were permanently raised compensation would have to be given to landowners?—Yes, undoubtedly.

57. *Q.* When a tank does not fill the lands in the foreshore will not be submerged at all?—No.

58. *Q.* Unless you get a full tank these lands don't get flooded at all?—No.

59. *Q* If you had shutters on the weir they would be sure of being cultivated when the water recedes?—Yes.

60 *Q.* What about the owners of tanks lower down?—Their rights must be considered to a certain extent.

61. *Q.* Every shutter of this sort would keep water out of the lower tanks?—In many cases there would be enough water to fill them all and surplus.

62. *Q.* (*Mr. Nicholson.*)—I understand that the island of Divi is too wet to grow dry crops?—That is my opinion. I know the rayats would prefer wet crops. It is probably water-logged.

63. *Q.* And it is too wet for sugarcane?—The tanks are very shallow. You could not store water economically for four or five months after the irrigation season was over.

CENTRAL PROVINCES.

Mr. G. M. Harriott, M.I.C.E., C.I.E., *Executive Engineer, Public Works Department, Central Provinces.*

(*Nagpur, 4th March 1902*)

Mr. G. M. Harriott.

1. *Q.* (*The President.*)—You have had a number of years' experience, Mr. Harriott, in this province?—Yes, I have been here nearly 22 years.

2. *Q.* You were here throughout the famines?—I was not here in the second famine, but I was here in the famine of 1896-97.

3. *Q.* What districts were you in?—In Raipur and Chhattisgarh.

4. *Q.* They suffered very much?—Yes, very severely.

5. *Q.* You are in charge of works of all kinds, both roads and irrigation?—Roads and buildings. In the Feudatory States there were also several minor tanks which I had to construct.

6. *Q.* I understand that there is not a single Government tank in these provinces?—There is no Government tank for irrigation. There is only one which is worked in a semi-Government way, by the District Council of Nimar. That is the Lachora Tank.

7. *Q.* That is apparently a small one. It has got only a small area under irrigation?—Yes, owing to a leak the supply has gone down very considerably. In the year 1896 there was very little water in it.

8. *Q.* You say, in reply to paragraph 4 of Question 3, speaking of the unsuitability of the soil, that the year 1894-95 was considered a good average agricultural year, and that in that year there were about 4,538 400 acres of rice lands under crop, of which 531,907 acres were irrigated. You say "the following areas were under the crops mentioned, and irrigation could without doubt have been applied to the whole of these lands." Were there any means of irrigating them?—No; these lands could have been irrigated.

9. *Q.* If there had been means, they would have taken water?—Yes. Irrigation was applicable to them.

10. *Q.* Then you go on to say—"Besides these lands, there were 2,588,992 acres under wheat, of which at least half is unembanked land, and it seems that this might have been irrigated; but practically none was irrigated. The question as to whether such lands can be irrigated is, however, disputed." What is disputed?- The irrigation of wheat on black cotton soil is the disputed question.

11. *Q.* (*Mr. Muir-Mackenzie.*)—Is it disputed how far embanking would be suitable for that soil?—I do not think there is much dispute about that. In the Jubbulpore district there is a very large area called *haveli* which is embanked and in which Revenue Officers state no irrigation whatever is needed.

12. *Q.* (*The President.*)—That is very important. At the bottom of page 3 you talk about irrigation meetings. What were these meetings?—In order to get the opinions as to what lands irrigation should be applied and to what crops we could apply irrigation, the Deputy Commissioners and the Commissioner of the Division were asked to hold meetings in the various districts. We got as many malguzars together as we could, and I questioned them on these points and noted their answers in my notes on different districts.

13. *Q.* Were the district officers present?—Yes, and several malguzars.

14. *Q.* Were reports made of the proceedings?—I made notes of the proceedings and sent a copy of them to District Officers.

15. *Q.* In reply to paragraph 4 of Question 3, you say—"I have no doubt that wheat grown on unembanked black cotton soil can be successfully and advantageously irrigated even in normal years." You refer also to one or two instances in your replies regarding the irrigation of wheat on black cotton soil. Am I right in supposing that the part of the Central Provinces which is most concerned in this question is the valley of the Nerbudda?—Yes the Nerbudda valley and the plateau to the north of that valley. The districts of Saugor and Damoh drain north-east into the Jumna valley.

16. *Q.* Supposing there was no question of black cotton soil, is the Nerbudda valley in other respects, by the lie of the valley, a suitable one for irrigation or must irrigation be tied down to a narrow deep valley?—We are tied to narrow deep valley; but the question, I do not think, has been seriously considered, as to whether anything in the way of an extensive irrigation scheme could be constructed in the Nerbudda valley. This question of black cotton soil has prevented any large project from being taken up in that valley. If it be carefully inspected and the question gone into, we may find that some scheme is possible.

17. *Q.* Have cross-sections of the valley been taken?—No.

18. *Q.* Have you got any discharges of the Nerbudda?—No.

19. *Q.* Could we have one taken now? I want to know what the Nerbudda is carrying about March. Have you got any officer there to whom you could telegraph?—I have an Assistant Engineer there doing survey in Jubbulpore. I could depute him to take the discharges.

20. *Q.* Have you any idea what the Nerbudda is carrying? Would it be about 1,000 cusecs?—I would not like to offer any opinion, but I should not be surprised if it is carrying about that. This is a dry year and we have had no rain since September, and it is just possible that the supply may be as low as it ever is.

21. *Q.* (*Mr. Higham.*)—Has the minimum supply ever been gauged? No.

22 *Q.* That might be done, this being a low year?—Yes, I can telegraph to Mr. Todd, the Assistant Engineer, and get him to take it.

23. *Q.* (*The President.*)—You say that from the lie of the valley *primâ facie* it does not lend itself to irrigation?—The run of a canal from the Nerbudda would be between the Vindhian plateau on the north and the Satpura range on the south, running through Jubbulpore, Narsingpur, Hoshangabad, and Nimar. It is a very narrow valley much broken by drainage, and where the canal would cross it is not suitable for storage, but it might be possible to store on the tributary streams.

24. *Q.* At the top of page 6 in your reply to Question 3, 9 (*d*), talking about *takavi* rules, you say that the cultivators do not seem to be well acquainted with the rules?—I do not think they know the rules well from what I have ascertained at these meetings,

25. *Q.* They do not know how favourable they are?—Yes.

26. *Q.* In reply to Question 5 (*c*) you say, "the amounts of such loans are limited to three times the rental of the holdings." Is that a local rule of the Central Provinces?—I cannot tell you whether it is a local rule or not. Mr. Sly will be able to tell you that. It is with reference to small holdings that I have said this. If a poor man is a good cultivator and is anxious to improve his land by irrigation, he must find security to get a sufficient loan. And he sometimes finds it difficult to get this

27. *Q.* I suppose loans would be given generally for wells?—They might be given for tanks; and in parts of Chhattisgarh also for embanked fields (*bhandhans* and *ghatas.*)

28. *Q.* In reply to paragraph 1 of Question 5 you say that "judging from the view taken of the subject by the majority of the malguzars, I think that a reduction of the rate of interest to 3 per cent. per annum should secure the object in view." You think that they are deterred by the high rate of interest?—The evidence here points in that direction. In Nimar malguzars had no complaint to make about the interest. In Saugor they suggested a reduction; and in Hoshangabad they were divided on the subject. I should say generally that malguzars themselves do not consider the 6 per cent. charge too high, though they think that a reduction might favour the increase of works, especially where the poorer people were concerned.

29. *Q.* I notice that you say in reply to paragraph 3 of Question 5, in talking about partial remissions and advances, "that the supervision be exercised by

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the State if possible through a malguzar." Do you mean to say through men of influence?—A malguzar is a man who practically owns the village; he is the proprietor. I would suggest a malguzar or a *panchayat* of malguzars. We might divide the districts into circles, and get the more reliable malguzars to form themselves into *panchayats* to deal with applications for and the supervision of each loan.

30. *Q*. Can you suggest any means by which the system of bunding fields can be encouraged?—I think that if the country is not level, we can help them with levels in the alignment of their *bunds*.

31. *Q*. As I gather, this system of bunded fields is not generally throughout the Central Provinces; it is in vogue more on the Jubbulpore side of the country? It exists also in the south of Bhandara in the Paoni Chauras, which is rice country.

32. *Q*. Do all the cultivators know about it?—Most of the cultivators in the northern part of the province know about it. It is generally known to cultivators throughout the province.

33. *Q*. If the cultivators had the means given to them they would probably avail themselves of it?—I think so. It is being newly introduced in Hoshangabad and Saugor.

34. *Q*. It is spreading?—It was adopted to a small extent in Saugor, but it is spreading. In Hoshangabad a good deal has been done since the last famine. There is a large area under *bunds* in Jubbulpore and also in Damoh.

35. *Q*. I am not going to ask you many questions just now, because, as long as we are in the Central Provinces, I hope you will be helping us. I wish to ask you generally one thing. What line of action would you advise Government to take to protect this province, so that it may be better able to withstand another famine?—I would construct as many irrigation works as possible. I should confine famine labour to irrigation works.

36. *Q*. Famine labour will be available when famine comes, but what shall we do to protect the country against famine? The introduction of irrigation is the only thing that will protect it. My opinion I have given in one or two paragraphs in my memorandum * People used to have a large stock of grain. I remember in my time, in the year 1886 or 1887, in Sambalpur where there was a partial failure, when I was giving orders to open one or two test works, I found that although people lost crops that year, yet they had two years' supply stored in each village. But these stocks are now going away. The railway is carrying them away. Poorer people spend all the money they get and then come to our works in case of a failure. The only way to protect ourselves against famine is by protecting the crops.

Note on irrigation in the Central Provinces, paragraph 102.

37. *Q*. Have you paid much attention to the subject of wells? I had some well-construction in Kowdia and Borasambar. Mr. Chapman was the Deputy Commissioner then But this well-construction was done more for sanitary purposes.

38. *Q*. For the water-supply of the village?—Yes

39. *Q*. Do you think that they are capable of being very largely increased in number?—I think they are.

40. *Q* Would you advise such an increase?—I would, especially in the wheat tracts. I do not think that wells are much used in the rice country. In wheat country, I think, they can be largely extended and they will do a great deal of good.

41. *Q*. (*Mr Higham.*) In all your schemes of irrigation, it is the month of October that you find it necessary to make provision for?—September and October; September is also a very important month

42 *Q*. These are the two months in which artificial assistance is ordinarily required?—Yes.

43. *Q*. And in other months of the year the rainfall is almost invariably sufficient?—It is generally sufficient. But it is occasionally unseasonable. For instance, this year we had two big breaks—one from the beginning of July to the 12th of July and the other from the 1st to the 15th September.

44. *Q*. It is quite possible that in the month of July, before the rains have set in strongly, you might require to give water to people who want it? Yes, especially in transplanted rice districts.

45. *Q*. That is, in order to provide them with water, you must have stored it in previous years?—Yes, you must bring forward the storage from previous years.

46. *Q*. Can you explain how you fix the area that is to be protected by each proposed work?—We take the worst of a series of years for which we have got rainfall statistics which have been abstracted for 1867 to 1899. We take the worst of this series of 33 years and we go back to the last year in that series in which the tank would have filled, supposing it to have been in existence, and then work down to the minimum year, to the year of drought, to see what area it could have protected right through, and that area we take as the area the tank could protect.

47. *Q*. Can you show me one of the forms for any of your works?—I do not think I have got one of them here. I will show one to you presently.

48. *Q*. Having ascertained the total area that the tank will protect, will you tell us how you propose to locate it?—Knowing the area that the work can protect, we take the area that it commands and would then get the Revenue Officers to pick out the land that would pay best for its protection. Then ascertain which of the people would be prepared to put their areas under protection. It may be done either voluntarily, or we might have a law to get the land under protection. But I think we would get the people voluntarily to put the land under protection without any difficulty.

49. *Q*. Suppose you have a tank irrigating, according to your estimates, 1,000 acres, over what area would you extend that protection; would you extend it only to 1,000 acres or would you spread it over 2,000 or 3,000 or 4,000 acres?—If we had to work with the strictest economy, we might select the land nearest the work. It would be better to take three times the area that the work could irrigate and extend our protection over that area, because that will afford greater protection in years of drought, as each area that is protected would have a certain amount of dry irrigation round it.

50. *Q*. Have you any idea, in regard to areas that are already protected under existing tanks, as to the extent of dry cultivation they have?—I should say in certain cases it would be three or four times the irrigated area.

51. *Q*. You think it is?—Yes, because the tanks that we have at present are generally small tanks lying low, and the higher ground round them is cultivated to a great extent: in fact, all but the tops of the ridges, where the soil is not very good. In Rajpur, for instance, the tops of ridges are not cultivated, while the rest of the land is cultivated.

52. *Q*. You cannot say what is the exact average proportion of dry cultivation to wet?—That I could not tell you. Mr. Sly would be able to tell you that.

53. *Q* If you allowed a man to have one acre of wet cultivation to three acres of dry, you would extend the protection over four times the irrigated area?—Yes, though it would cost extra in distribution in the greater length of the channel and loss in percolation.

54. *Q*. (*The President.*)—Would you anticipate finding wet and dry cultivation mixed up in that way: that is, a field of wheat alongside a field of rice? Not where you have rice; there you have to take the whole plot. But where you have wheat and extend the irrigation to the wheat area, rice begins to be planted, and then you have them mixed. You might have *juar* and cotton on dry land and use some portion of the land near it for rice. But wheat and rice come at different times. Rice is a monsoon crop, and wheat a winter crop. Very often they take catch-crops of rice, and then sow wheat on the same land in the winter months; for instance, in bunded fields under the *haveli* system in Jubbulpore, there is something like 50,000 acres on which they take a crop of rice before the wheat crop.

55. *Q*. Do you mean to say that there are 50,000 acres of double crop land?—Yes.

56 *Q* (*Mr. Higham.*) I understand that where you have rice cultivation you have not much dry cultivation?—Yes. We have not much dry cultivation in rice lands In regard to rice lands, it would be better to select our area as near the reservoir as possible.

57 *Q*. I think that all your calculations are based on the assumption that you are going to irrigate rice lands? Yes We have decided to take up the whole of the works in the rice areas first until we get more information about wheat areas.

58. *Q*. Supposing you protect certain areas under rice in the way you suggest, and suppose there is a dry year when there is a strong demand for water for dry crops, how are you going to irrigate them?—We would not irrigate them because dry crops would not be under protection. We could not irrigate land outside of the "protected" area We have calculated our works for irrigating the protected area only.

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59. *Q*. You calculate that you require so much water for rice; suppose a man, instead of putting down rice, puts down sugarcane, he will want water not only in October but also for the whole of the hot-weather months?—Our calculations at present are for rice, because sugarcane is grown only on a very small area now. We have not taken out the calculations in detail for each crop yet. In estimating finally the area that each work can protect, we will consider the requirements of each crop separately; fix the duty for it, and then work out the area that the scheme can protect.

60. *Q*. You will have to know exactly what people are going to do before you begin?—To a certain extent, we provide in our projects for the improvement of crops, but we are not providing for change in crops.

61. *Q*. (*The President*.)—You are providing for a tank containing water before the beginning of the monsoon?—Yes.

62. *Q*. You want water on the 1st of June?—Yes.

63. *Q*. If there is a great demand for wheat in the *rabi*, would you still reserve water for the hot weather?—Yes. If there is to be any *rabi* under protection we will calculate the water that will be needed for it.

64. *Q*. (*Mr. Higham*.)—You propose to select beforehand the lands of particular owners who express a desire to take water and to confine protection to them?—Yes; we will give water only to those who will put their lands under protection. I think we must know what land we are going to give water to. Of course there may be a provision by which one cultivator can remove his land from protection, and another place his lands under protection in his stead.

65. *Q*. Then you will have a system of applications before you open your works?—Yes, we would ascertain what amount of land the people are likely to put under protection.

66. *Q*. Is that necessary; instead of confining the supply of water to particular plots, could you not distribute the water to everybody rateably; would they not all apply for it?—Yes; it would be for the Revenue Officers to say whether that could be done.

67. *Q*. The system that you contemplate seems to favour those who come first in the field and to exclude others?—No. We will get our land as near the tank as possible, and we will go further away if we don't get a sufficient area under protection near it.

68. *Q*. That would be to concentrate the benefits of protection to a few individuals who come first with their application. You would take the whole of those applications and you would guarantee protection for their lands, while others will be left out in the cold?—We would not have water for more than a certain area.

69. *Q*. But you should distribute what you have over as wide an area as possible?—We can have different *chaks* and irrigate certain portions in each without having one *chak* nearest the work and distributing water there. But that would rest with the Revenue Officers who would make the best arrangements. All that we can do is to guarantee a certain supply of water for a certain area.

70. *Q*. You would not allow a man to put in sugarcane unless he had applied for water beforehand?—Unless we know that he requires water for sugarcane, how can we say whether we could give him water for it or not.

71. *Q*. You would not allow him to irrigate as he likes?—I don't think we could do so unless we find that our supplies exceed the demand. If we find that we have water to spare, we can give extra water to sugarcane.

72. *Q*. You assume that you will get Rs. 2 for every acre that you protect?—I think that we can rely upon getting Rs. 2 eventually.

73. *Q*. Is that an all-round rate or is it an average of a scale of rates? Would you charge a higher rate on particular crops or have an all-round rate?—I think we should have a scale of rates on account of the varying soils that will be put under protection. There are certain soils in which the best class of rice can be put down, while there are others in which you cannot put down the best class. For instance, the higher soils in Raipur will not take the best class of rice. If you irrigate them, you could only put second class rice on them.

74. *Q*. Would you have a special rate for garden crops or sugarcane which would want water all the year round?—Yes. There would be a special rate for sugarcane.

75. *Q*. If you guarantee protection to a certain area, you would fix the water-rate for the whole area, whether water is required for a particular year or not? Suppose it was a wet year and nobody wanted water, they would still have to pay Rs. 2?—Yes. They know that water is kept for them for the following year in case of drought.

76. *Q*. If a man puts down sugarcane, you would charge him Rs. 2 and something extra for cane?—Yes. Practically it is a double crop, as it takes water throughout the year. Our rate of Rs. 2 is for rice which has a season of 4 months; but if we had a crop extending over 6 or 8 months, we should charge a different rate.

77. *Q*. What is this Rs. 2 rate based upon?—On our experience at present in Chanda, Bhandara, and Nimar. In Chanda at Sindawahi village they pay Rs. 3 per acre per crop for rice, and at Kachapar village Rs. 6-5-4 for sugarcane. At Lachora tank in the Nimar district Rs. 4 per acre is paid for irrigating rice and wheat and Rs. 10 for sugarcane.

78. *Q*. To whom they pay?—In Nimar they pay to the District Council.

79. *Q*. Is the irrigation from a tank?—From the Lachora tank.

80. *Q*. Then why should you suppose that we would get only Rs. 2?—The reason why I suggested Rs. 2 was, that in the Bhandara district it is more or less the recognised rate for the sale of water from the village tanks at present.

81. *Q*. That is in years when they want water?—They can only have water when it is available. If a man has water in a tank, he need not give it to another person unless he can spare it; but if he gives it, he charges him Rs. 2. The cultivators are guaranteed no protection.

82. *Q*. If a plot of land is guaranteed water through all seasons and there is a great chance of an increase in the yield, Rs. 2 seems to be a small rate?—I admit that. I think it should be higher, but at present a higher rate is not recommended. The Revenue Officers would not recommend even Rs. 2 to start with.

83. *Q*. That is the maximum that the Revenue Officers can be got to recommend?—Yes.

84. *Q*. Even that would not be introduced immediately?—No. They do not expect to get that at once. We may get it in some places. In some portions of the Bhandara district people might willingly come forward and take water at this rate, but in other districts they may hold back till they ascertain what the benefits from irrigation actually are.

85. *Q*. Have your malguzars and others among the people expressed any opinion as to what they would be willing to pay?—You will probably have a malguzar coming before you and he will express a definite opinion. He is the man who sold water during the famine at Rs. 20 per acre.

86. *Q*. What is the normal rate?—The normal rate for selling water in Bhandara is Rs. 2. That is what they recognize generally.

87. *Q*. (*The President*.)—That is what the owner of a tank gets?—Yes. He gets it in the year a man takes it.

88. *Q*. (*Mr. Higham*.)—Can you tell me something more about the tank in Nimar; under what conditions did it fall into the hands of the District Board?—It is an old tank constructed in the time of the Moghul Emperor. It fell into disrepair and was not being used. When Colonel Keatinge was the Deputy Commissioner he had it repaired and renewed. It was then handed over to the District Council as the best body to work it, and they have been working it since.

89. *Q*. Does the District Board find money for repairing it, or is it repaired by the people?—That I cannot tell you. It was repaired many years ago and the District Board did find the money for those repairs.

90. *Q*. How is it maintained—by the people or by the District Board?—The District Board.

91. *Q*. They keep an establishment?—There is very little establishment required.

92. *Q*. Has the tank been in good repairs?—No; there was a leak in it which reduced the supply in 1899. That is the reason why irrigation has been

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falling off. The leak is there still and it is not repaired. It requires to be opened up at the leak and then carefully repaired.

93. *Q.* Why do not the District Board repair it; can't they afford to do it?—No.

94. *Q.* Do they get a water-rate?—Yes. But it has dwindled down to very little, the area irrigated being very small.

95. *Q.* But according to you they got a very good rate?—Yes. The area that is irrigated was about 300 acres, but it has run down to some 80 acres.

96. *Q.* Has it dwindled owing to this leak?—Yes, to a great extent.

97. *Q.* Do not the District Board think it worth their while to keep it up?—I cannot tell you the details, but I know that it is not being repaired. There is no doubt that the area has fallen off.

98. *Q.* Looking at the tank as a commercial speculation, you say that the tank was made by the Moghul Emperor and all that the managers had to do is to prevent it from leaking and to keep it in an efficient state of repair. Apparently they do not find it worth while to do so. Is it due to the fact that they do not get enough income to keep it in good repair, or is it due to the inability of the District Board to manage it?—The area irrigated has fallen off considerably and the little revenue they get does not cover the expenses.

99. *Q.* Why did it fall off?—The rate had something to do with it. The rate of Rs. 4 is too high. Very possibly it may be due to the inattention and bad management by the District Council. In a note sent by the Executive Engineer he says that it has fallen off owing to the high rate demanded for irrigation, *viz.*, Rs. 4 and Rs. 10 on sugarcane.

100. *Q.* (*Mr. Craddock.*) Where the rates increased?—Yes, from Rs. 2 to Rs. 3 and then to Rs. 4. The District Board lowered the rate in 1899, but there was very little water, and the people found that even though they paid this rate, they could not get water.

101. *Q.* Are there many irrigation tanks in zamindari areas?—There are two small irrigation tanks—one in Nawegaon in Bhandara and another in Seoni in Bhandara.

102. *Q.* Whose property are they?—The malguzars'.

103. *Q.* Do they charge anything for water-rate?—One malguzar, who will give evidence, does not charge anything.

104. *Q.* Are there any large irrigation tanks in such areas?—No. There is a tank at Wararband in the Raipur district, but it is not used for irrigation.

105. *Q.* You have submitted a great many projects. Supposing it is decided to make a commencement and to begin the works, in what order would you recommend them to be taken up?—I would recommend the best projects in the most distressed parts of the country.

106. *Q.* What do you mean by the best projects?—The most promising projects.

107. *Q.* From a revenue point of view?—Not only from a revenue point of view. The projects that the Revenue Officers would suggest starting with. For instance, any projects that you take up should be projects in places where people would welcome irrigation. That will show other people the benefit.

108. *Q.* Would you start the work in one district?—In parts of Bhandara, Balaghat, Raipur, and Bilaspur.

109. *Q.* In four different districts?—Yes.

110. *Q.* (*The President.*)—Have you got complete projects in all these four districts?—Yes.

111. *Q.* (*Mr. Higham.*) Can you tell us anything of the discussion that took place in the seventies about irrigation in the Wainganga valley?—Projects were prepared for irrigating the Wainganga valley from the Kanhan and the Pench rivers. The project from the Kanhan was to irrigate land to the west of Nagpur, the eastern parts of Wardha, and the western parts of Bhandara. A greater part of this country was cropped with *juar* and cotton which was said not to require irrigation. The project was an extensive one, and when it was submitted to Government of India they replied that it was too expensive and suggested the submission of smaller projects. Then a scheme was proposed from the Pench river. The point of that scheme was an anicut and canal from the Pench, supplemented by a reservoir at Ramtek on the Sur river to irrigate a portion of the country to the north-east of Nagpur and the west of Bhandara. This project was submitted and was also said to be too expensive. The order of the Government of India was that the estimates for the projects were to be cut down to 12 lakhs. These three schemes were then revised. Sir John Morris, who was then the Chief Commissioner, strongly recommended that the Nawegaon tank reservoir, the revised estimate of which was Rs. 9,61,958, should be sanctioned as an experimental scheme.

112. *Q.* What year was this?—This was in 1874. The project was submitted to the Government of India, and it was finally decided that the State would not sanction a project on so large a scale, and further investigation was stopped, as it was considered that irrigation was not urgently needed in the province, and there the project ended. Just at the time that this project was under consideration, it appears that a report was asked for from the Inspector-General of Irrigation on the possibilities of irrigation in India, and the tank project of the Central Provinces was put down about the 9th on the list, which meant that it would not be sanctioned till about 1900. Then Colonel Mayne, who was the Chief Engineer at the time, in a Note to Chief Commissioner, said that this meant that irrigation in the Central Provinces was practically shelved, and that in order to protect us from famine it would be as well to have a railway communication to bring in grain supplies when necessary. It was then that Sir John Morris asked for the Nagpur-Chhattisgarh Railway.

113. *Q.* Because he could not get a canal?—Because he could not get irrigation.

114. *Q.* Has the Ramtek project been worked up?—It was revised and full details were submitted to the Government of India. It was approved, because the Government of India in the reply mentioned that the project had been carefully prepared. It has now been brought into line with other projects.

115. *Q.* Have you got it here?—Yes.

116. *Q.* Will you show us the general plan?—Yes.

[At this stage the scheme was explained by the witness by the aid of the plan.]

117. *Q.* (*The President.*)—As regards this scheme, what would happen in a year of such drought as you have had?—It would protect an area of 82,000 acres. That has been worked out from the rainfall statistics for a series of years.

118. *Q.* You could count upon this reservoir having a large supply even in the driest year?—Yes.

119. *Q.* What is the extent of the catchment area from which it draws water?—82 square miles.

120. *Q.* The soil is chiefly black cotton?—Chiefly black cotton, but a good deal is *muram*.

121. *Q.* (*Mr. Muir-Mackenzie.*)—I should like to put one question—it is a question which I should perhaps address to my colleagues and do not to Mr. Harriott—as to whether it is not a wasteful method to build a tank to contain a great many more millions than are required in a famine year. You will store 4,000 millions?—Yes.

122. *Q.* And then you give out only 2,000 millions and odd?—Yes.

123. *Q.* You have to leave the rest for the next year?—Yes.

124. *Q.* Then that means that you have to build a very large tank in order to give a small supply?—We don't do it in that way. We design our tank so as to take the greatest advantage we can of the site; we then estimate the area which the tank as designed will protect.

125. *Q.* That is, I understand, that you work out the area from conditions of minimum rainfall in a series of bad years?—Yes.

126. *Q.* You store enough water to irrigate a very much larger area in a good year?—Yes.

127. *Q.* In order to give 2,000 millions you have to store 4,000 millions and you have to make a big tank?—Yes.

128. *Q.* Is not that a very expensive method of storage?—The expensive part of it is the loss by evaporation between October of one year and June of the other. If we do not provide for this, we cannot have the area protected.

129. *Q.* (*Mr. Higham.*)—That is just the point I wish to ask. Putting protection on one side, you would get greater revenue by working in the way you propose than you would by emptying the tank every year?—I think so.

130. *Q.* If you empty it in years when there is plenty of rainfall, you will get a very small rate indeed?—Yes, as a matter of fact, there are many years in which probably no water will be taken.

131. *Q.* But if you reserve it for a year of drought, the cultivators will be able to pay all round a higher rate than they otherwise would?—Yes. For giving them protection we can ask a fair rate.

132. *Q.* (*Mr. Muir-Mackenzie.*)—Is it to be paid every year or only in the protected year?—Every year.

133. *Q.* (*Mr. Higham.*)—This Ramtek tank according to your table is one of the cheapest and the most promising of all on the list?—Yes, it is.

134. *Q.* Is it one that you would propose to begin at once?—Personally it is one that I should propose to begin at once. I think it is a very good experimental scheme. It will to a great extent solve a great many questions. Not only it shows what irrigation can do, but also how far it can be extended on black cotton soils. If it proves a success, it opens up irrigation from the Pench and the Kanhan, by which we could protect a large area.

135. *Q.* There are two objections raised against it. In the first place, it is all cotton cultivation?—It is wheat, *juar*, and linseed. There are about 7,000 and odd acres of garden crops and rice.

136. *Q.* There are 7,000 acres of rice now?—Yes.

137. *Q.* That would extend if water were made available?—The Deputy Commissioner in his note says that it would.

138. *Q.* To the extent of 32,000 acres?—Whether it would exactly go to that extent I cannot say.

139. *Q.* 16,000 acres would be rice and 16,000 acres would be wheat?—Yes.

140. *Q.* The other objection is that this part of the country does not want protection?—It does not want protection as much as other portions of the Province. But it did suffer in the last famine.

141. *Q.* (*Mr. Craddock.*)—There was no relief work there in that year?—No; but there seems to have been loss of crops.

142. *Q.* (*Mr. Higham.*)—Still much protection as you could afford is much less than what you would give to other parts?—Yes; I recommend this project as an experiment, because it will be a favourable one. There are some other big projects which are now being worked out in detail.

143. *Q.* In that plan which you showed us the area that is marked for irrigation by the Ramtek project is said to be 62,000 acres?—Yes, the red portion.

144. *Q.* You say you would irrigate only 32,000 acres?—Yes.

145. *Q.* That would be half the area commanded?—That only refers to the portion marked red. But if the Ramtek project is worked as proposed, we can irrigate right down to Bhandara, where there is good rice cultivation.

146. *Q.* That is what I was going to ask you. Would you confine yourself to that tract, or would you go beyond that?—In regard to that particular scheme I would like to go beyond that.

147. *Q.* (*The President.*)—Is it a part of your project to feed existing tanks?—Yes. As a matter of fact, in the Central Provinces we have to combine direct with indirect irrigation—in Chhattisgarh especially.

148. *Q.* (*Mr. Higham.*)—Suppose you make all these tanks and canals that have been proposed, how do you suppose that they will be maintained; will they be maintained entirely by Government or by the people?—We will have to do the repairs to masonry works and to embankments; but I think the people could be got to clear the channels every year.

149. *Q.* You allow certain rates in all your tables for maintenance?—Yes.

150. *Q.* 8 annas per acre?—Yes.

151. *Q.* Does that include the keeping of the channels in order?—It excludes that. I reckon on channels being maintained by the villagers. I assumed as a minimum a scheme that could protect 800 acres, and I estimated in my note that Rs. 400 could maintain such a scheme, but the greater number of our works will protect a much larger area and the cost per acre will be proportionately smaller.

152. *Q.* You contemplate that the people themselves will keep the channels in repair?—Yes.

Mr. G. M. Harriott.

153. *Q.* Are they not likely to clear out channels to twice their proper width? I do not think that they will do any more work than they have to do. They would not be able to secure more water by widening channels, because the supply depends on the outlets.

154. *Q.* If Government were to repair all the works, the rate would have to be increased?—It would probably have to be increased to 12 annas.

155. *Q.* In the estimates for these works you propose to acquire for Government the whole of the area that will be submerged by the tanks?—Yes. We propose to take up not only that but also the area that will be taken up by channels—the land required for main channels.

156. *Q.* The question has been considered in other Provinces whether it is always necessary to compensate the people for the land taken up for the purposes of a tank; whether they would not allow you in many cases, not in all, to store water provided you do not interfere with the rights of ownership and you allow them to cultivate on the margin of the tanks if the tanks run dry, and also allow them to cultivate the bed in the dry year?—I think there are cases in which some proprietors might forego compensation for land on the lines suggested or for small areas where they could get a crop in the winter along the border of the tank when the water surface recedes. Of course we could not rely on this in every case.

157. *Q.* Any estimates made for tanks should provide for full compensation; but what I mean to say is that men should be allowed the option of foregoing compensation provided the Government could have such control as is necessary to give as much water and run it out as much as it pleased. This would reduce the cost of many of the works, and it would also very often overcome the opposition of people who do not like to give up their land. I only mean to suggest this point so that it may be considered when any difficulties arise with a view to overcoming opposition?—I think possibly there may be cases in which some proprietors might forego the compensation in order to retain the proprietary right in the land.

158. *Q.* (*Mr. Craddock.*) This would also reduce the amount to be paid as compensation?—Yes.

159. *Q.* (*Mr. Muir-Mackenzie.*)—I want to try and get clear as to the degree to which the Province is liable to famine and the circumstances under which that liability occurs. I see from your rainfall statistics there were only two years in which the rainfall was deficient?—Only two years when there was absolute failure.

160. *Q.* That was in 1868-69 and 1899-1900?—Yes.

161. *Q.* On the other hand, in 1868-69, there seems to have been only partial scarcity. There was nothing like what occurred in 1899?—There was acute distress in about eight districts, but I do not think it was felt throughout the Province or as severely as in 1899.

162. *Q.* It was only the heavy rainfall in September that saved the greater part of the country, and acute distress was confined to certain districts that are mentioned in your note?—Yes. They were Saugor, Damoh, and Jubbulpore in the north, Bhandara and Balaghat in the south, and Chattisgarh.

163. *Q.* Apparently it was not a distress or famine like that of 1899-1900?—Apparently not.

164. *Q.* On the other hand, 1896-97, you had excessive rain?—It was a year in which there was unseasonable rainfall.

165. *Q.* It was excessive on the whole?—Yes.

166. *Q.* And yet you had a severe famine?—Yes; but it was not caused by the heavy rainfall.

167. *Q.* What I want you to let us know is, how far your projects of irrigation will provide against a year of totally deficient rainfall. I understand that the Ramtek tank would fill. Are you confident that all other tanks would fill?—We have taken the worst series that has occurred in 33 years, and we have estimated the area that could be protected through them to a year of minimum rainfall. It is to guard against years of totally deficient rainfall that we propose working on this protective system.

168. Q. How far would other means of irrigation—means auxiliary to irrigation—serve you in a year of totally deficient rainfall; would the *haveli* system of irrigation be of any use in such a year?—It has been of use in these two famine years.

169. Q. Wherever it has been practised?—Yes.

170. *Q.* The land under it had full crops?—I do not think they had full crops.

Mr. G. M. Harriott.

171. *Q.* An appreciable crop?—They run up to 8 annas in Jubbulpore.

(*Mr. Craddock.*)—They did very poorly in 1899-1900.

172. *Q.* (*Mr. Muir-Mackenzie.*)—Would the *haveli* system of irrigation in wheat land be an efficient protection in a year of utterly deficient rainfall like 1899-1900?—From what I gather, people seem to think that they could get somewhere about 8 or 10-anna crops.

173. Q. You are unable to form your own opinion?—Yes, because I did not see any part of the wheat country in these years. I have been in the rice country.

174. *Q.* (*The President.*)—I gather that *haveli* is a *rabi* system?—It is a combined system. In some parts they take a crop of wheat during winter and a catch-crop of rice during the rains.

175. *Q.* (*Mr. Muir-Mackenzie.*)—There is another system that has been auxiliary to larger schemes of irrigation—*bunds* across *nalas*?—Yes.

176. *Q.* That is different from the *haveli* system?—I think it is more or less included in the *haveli* system. Do you mean tank *bunds* going down the *nalas* ?

177. *Q.* Yes; have you seen anything of such a system?—I have seen it in some places. You have a number of *bunds* down a valley, and sow behind the *bunds*.

178. *Q.* Were any good crops obtained in 1899-1900 ?—That I could not tell you.

179. *Q.* Coming to wells, did not wells give good crops in 1899-1900 for such areas as were irrigated?—In wheat areas it did.

180. *Q.* Would you not be prepared to say that, as a measure of protection in wheat areas, there is nothing so efficient as wells for a year of totally deficient rainfall ?—For the area they can irrigate, well-irrigation is effective. But the area they do protect is small.

181. *Q.* Was the amount of water in the wells very much less in 1899-1900 than in ordinary years?—Yes, I should say it was. But the wells did seem to meet the demand made on them.

182. *Q.* They irrigated as much as usual?—Yes.

183. *Q.* You think the water level was materially lower ?—Yes, but they got what they wanted.

(*Mr. Rajaratna Mudaliar.*)—On page 12 of the Note on Irrigation you find the figures given. It is 64,000 acres against a normal of 74,000 acres.

184. *Q.* (*Mr. Muir-Mackenzie.*)—Some witnesses, if I understand the papers rightly, have advocated encouragement being given to people by granting *takavi* on liberal terms to enable them to build tanks for themselves. Would these small tanks, such as the people are likely to build, be of any use in a year like 1899-1900?—No, the rice districts of this Province show that they would not.

185. *Q.* On the other hand, in a year like 1896-97, when there was large rainfall in the beginning of the season, would they not be of very great value?—They were not as valuable as it was anticipated that they would be.

186. *Q.* I gather from Mr. Sly's statistics that in the year 1896-97 the area irrigated from tanks was 647,000 acres. That was nearly the largest area on record?

(*Mr. Craddock.*)—Much of that irrigation was imperfect. They might have had one small watering.

(*Witness.*)—If you look at page 12 you will find that the area irrigated under tanks fell from 536,213 acres in 1894-95 to 176,997 acres in 1899-1900.

187. *Q.* (*Mr. Muir-Mackenzie.*)—The explanation, I understand, is that the irrigation was of an imperfect kind.

(*Mr. Craddock.*)—It was partly because the rainfall was excessive and up to the end of August they let a lot of water go. They had a series of three wet years and the rainfall promised so well up to the end of August that a great many were careless.

(*Mr. Muir-Mackenzie.*)—Nevertheless they did some irrigation.

(*The President.*)—Do you know whether the rains fell continuously?

(*Mr. Craddock.*)—Yes, till about the last week of August.

(*Witness.*)—There is one other point. Many of these small tanks were damaged by heavy rain. A big plump of rain damages small tanks. Whenever we get a plump of rain small tanks fare worst. A part of the *bund* gives way.

188. *Q.* (*Mr. Muir-Mackenzie.*)—Are these small tanks kept in good repair or bad repair?—I should say, personally, they are kept in very poor repair.

189. *Q.* Do they breach frequently?—Yes, when we get a good plump of rain.

190. *Q.* Are breaches promptly repaired?—In a way they repair them; they patch them up.

191. *Q.* Would you recommend that Government should examine these tanks with the object of instructing people in making better arrangements for the waste weirs?—Instruction might be helpful in the case of waste weirs. But, as far as the construction of these tanks is concerned, people are quite able to do it themselves. I do not think the interference of Government will do any good. But in connection with large tanks which we are to fill, I certainly think the Government should help them to make them properly and to provide proper sluices.

192. *Q.* When tanks are filled from Government storage ?—Yes.

193. *Q.* I see from Mr. Hutton's note appended to yours there were some old breached tanks?—There are very few. At present they are not likely to be taken up or immediately wanted. Either the people have left the villages or they are not using them. They let the land go to waste.

194. *Q.* If the tank was repaired, would not people come back to the village and take up the lands?—Not readily. They might in time. In every district I asked about it, and the reply was that they were tanks from which we would get no immediate benefit.

195. *Q.* Are they very few ?—Yes, very few.

196. *Q.* Are they silted up ?—Not silted up. The *bund* had been breached and the owner was too poor to repair the tank, and so it has fallen into disuse.

197. *Q.* Are they small?—Yes.

198. *Q.* No tanks which could irrigate several hundreds of acres ?—Many of them could only irrigate 50 acres; sometimes 100.

199. *Q.* We shall want a good deal of information about famine programmes. Will you be able to get it for us ?—Mr. St. Clair, Superintending Engineer, is the officer who can give you the information. As far as our famine programmes go, I have estimated the value of the work that can be done by famine labour for all the projects and have included them in the supplementary note under the column "Amount of work that could be done by famine labour." You will see in column 18 the extent to which the work can be carried out by famine labour and the probable cost of the project.

200. *Q.* Will you be able to put in a full programme of famine works?—I can get that from Mr. St. Clair.

(*The President.*)—It has been particularly suggested to me by Mr. Ibbetson to see the excellent system you have of maps illustrating your programmes.

(*Mr. Craddock.*)—They were prepared for the last famine.

201. *Q.* (*Mr. Muir-Mackenzie.*)—I suppose that a large number of your projects are suitable for employment of famine relief labour?—Yes.

202. *Q.* You say that famine labour could be suitably employed on *haveli* or *nala bunds*?—I should say that famine labour can be employed profitably on them.

203. *Q.* There would be no difficulty of organization?—I should not think so.

204. *Q.* So long as the Public Works Department gave the levels the works could be carried out by the Civil Department?—I think so; we could assist them with levels.

205. *Q.* Did the Public Works Department employ famine labour on such works?—Very little.

206. *Q.* Is it not necessary to make waste weirs for these *bunds* ?—It is very necessary. I can give you a case in point. Sufficient room should be left for flood water. I inspected three fields belonging to Nathu Ram, Malguzar of Saugor. He had two *bunds* one above the other. The top *bund* got breached and the whole of the crop above the top *bund* had failed.

But the portion between the two *bunds*—the lower one did not breach—had a beautiful wheat crop when I saw it in November.

207. *Q.* (*Mr. Rajaratna Mudaliar.*)—Were any irrigation works undertaken during the last famine?—Only small tanks. There were a few larger tanks taken up in Raipur and Bilaspur. They were started but not finished.

208. *Q.* Do you think it is necessary to complete these works?—They should be completed at once.

209. *Q.* At once or reserved for another famine?—At once. What we require at present are really some works which will give us data.

210. Q. If they are not completed, all the expenditure hitherto incurred will be wasted?—It would mean that a certain amount will be wasted, but not all. Even later on we could utilise some of the works already done.

211. *Q.* There are over 31,000 tanks in this Province. Are they all private tanks?—They are all private tanks except Lachora, which is worked by the District Council of Nimar.

212. *Q.* Does the Government derive any wet revenue from these tanks?—Yes. I think a wet rate is put on the land that is irrigated from the tanks. It is included in the rent.

(*Mr. Craddock.*)—Irrigable land is assessed at a higher rate.

(*Mr. Muir-Mackenzie.*)—It is the Settlement Officer who actually determines the rate. Is it not?

(*Mr. Craddock.*)—Yes.

213. *Q.* (*Mr. Rajaratna Mudaliar.*)—The revenue under the tanks is not given?—It would be very difficult for me to arrive at that.

214. *Q.* (*Mr. Muir-Mackenzie.*)—Are not the rent-rates of particular villages recorded?

(*Mr. Craddock.*)—It is fixed on the holding as a lump.

(*Mr. Muir-Mackenzie.*)—Is there any record of rent-rates?

(*Mr. Craddock.*)—There is a record of rents from which we can deduce the rates.

(*Mr. Muir-Mackenzie.*)—Would it be possible to get a statement as to that?

(*Mr. Craddock.*)—I think so. It is perfectly possible to get a general statement. The rates vary greatly from village to village under our system.

(*Mr. Muir-Mackenzie.*)—Still I should be very glad if we could have it. I know that your rates are low.

(*Mr. Craddock.*)—We will certainly give you that information.

215. *Q.* (*Mr. Rajaratna Mudaliar.*)—Your system is that on each individual holding you fix a certain lump assessment?

(*Mr. Craddock.*)—Yes.

(*Mr. Muir-Mackenzie.*)—That assessment is for the purpose of rent. The revenue assessment is taken on the whole village or whole estate.

216. *Q.* (*Mr. Rajaratna Mudaliar.*)—On the total revenue of the village you fix a certain proportion as Government revenue. What is the control you exercise over landlords to keep these village tanks in repair?—No control at all.

(*Mr. Craddock.*)—There are certain tanks in certain villages where the condition is that the landlord should repair the tanks, but that is a condition which it is difficult to enforce.

217. *Q.* (*Mr. Rajaratna Mudaliar.*)—Suppose ample funds are available, do you think that the nature of the country and the depth of subsoil water would admit of a large increase in the number of wells?—I think a fairly large increase. A considerable number of wells might be made. But I do not think that we could rely upon their protection for a very extensive area. We have to rely on tanks and large irrigation schemes for the protection of any appreciable areas.

218. *Q.* From the figures on page 12 of your note, may we take it for granted that 64,000 acres under wells can be put down as protected even in the worst years?—Yes.

219. *Q.* Do you think that the area could be trebled or quadrupled, if the number of wells be increased?—I should think it would be possible certainly to double that area.

220. *Q.* In preparing your projects you take Rs. 2 as the water-rate to be levied?—Yes.

Mr. G. M. Harriott.

221. *Q.* I think you said that the rate would be charged in all seasons, whether water is taken or not. Am I correct in supposing that?—Yes, because we offer protection. We reserve water from one season to another. Not only that, but we keep water for the same season. I would give you an illustration. Suppose there is an area in which three waterings are required and our project is so designed as to protect 1,000 acres. But there are 3,000 acres below the work. If you gave one watering to the 3,000 acres, the whole crop might fail for want of more water.

222. *Q.* Your Rs. 2 water-rate is intended to cover how many waterings?—Whatever number of waterings may be required for each year. In a year of drought they might require four to five waterings; in a normal year one or two only.

223. *Q.* You would levy the rate whether water is taken or not?—Yes. But the charge would be the same in years of drought as in normal years.

224. *Q.* Do you think that in years of normal rainfall people would take water?—They will generally take one watering in October.

225. *Q.* In all seasons?—Yes. There are very few years in which they will not take one watering in October. In very many years they will take one in September and another in October.

226. *Q.* You don't think the rate is high?—I do not think so. People will, I think, willingly pay it once they see the benefits irrigation confers. As a matter of fact, I feel certain that after they once settle down to taking water, we will find it difficult to cope with the competition that will arise by people trying to get their lands into the area protected.

227. *Q.* The number of *kachcha* wells is very large. How long do they last?—They just last a season. They have to be cleared once a year. In black cotton country they fail, and it is very difficult to keep them. In parts of Hoshangabad there are *kachcha* wells near rivers where the soil is hard and there they have been useful. They do prove useful to a certain extent in years of drought. But I would not recommend them to be run as protective works.

228. *Q.* (*Mr. Craddock.*)—You said that your information was that malguzars and other people when they gave water took Rs. 2. Is that so?—They sold water at Rs. 2 an acre.

229. *Q.* It is not the case that a man pays for water for every year that there is water in the tank, and he does not pay in those years when there is no water; if there is water and the man does not take it, he has to pay the rate all the same?—I have not had these cases before me.

230. *Q.* The only case in which he is excused from paying is when there is no water?—The information that was given to me was that malguzars stored water and charged Rs. 2 per acre for a crop for the year. They only gave water to the cultivator if they could spare it to him.

231. *Q.* It depends upon whether water is available or not?—Yes.

232. *Q.* If the water is available and the man does not choose to take it, he has to pay?—That I would not say. When they do get water and when water is given to them they are charged Rs. 2 an acre.

233. *Q.* Did you say that they said Rs. 2 for wheat also?—Yes.

234. *Q.* Don't you think that on the whole the wheat crop succeeds on an average oftener than rice crop without irrigation?—It does to a great extent. It does not require so much water as rice.

235. *Q.* Don't you think if there is a crop which can succeed without irrigation better than another crop, people would pay less for the crop that usually succeeds without irrigation than they would be willing to pay for the crop which cannot succeed without irrigation?—In the case of wheat, there might be some allowance and we might lower the rate, because we do not use so much water and so could protect a larger area.

236. *Q.* Don't you think that water would be required much more frequently for a term of years for rice than for wheat?—I would not say that, because wheat can benefit by irrigation every year in October before sowing. If you look at the rainfall statistics, you will see that the rainfall of October very seldom reaches four inches, which is about what is required for wheat. I think wheat would benefit by irrigation every year.

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237. *Q.* The rainfall in September will not do?—No They want it in October. The storing in bunded fields shows that watering before sowing benefits wheat. This has also been proved on the Betwa Canal, where since the 1896-97 water has been taken for irrigating wheat on *kabar* soil every year before sowing.

238. *Q.* (*Mr. Craddock.*)—They have not had a wet October since 1894?—The average rainfall in the month of October during this series of 33 years is 1·76 inches. Take the Saugor district, where the average rainfall in October is 1·3 inches; there the wheat is on black cotton soil. There are only three years in the whole series of 33 years in which it has gone over four inches.

239. *Q.* Would you not attach enormous importance to the fact that wherever you get rice, people have concentrated their efforts to irrigate their rice, whereas wheat is hardly irrigated at all; don't you think there must be some reason for this? That is because we hold that the bunded fields are not irrigated. If you take in the bunded fields, there is considerable irrigation.

240. *Q.* Only absolutely level tracts?—Bunded fields are applicable to level tracts. When I was taking evidence at Jubbulpore, both the Deputy Commissioner and the Commissioner tried to find out whether we could irrigate wheat lands outside the *haveli*. But the people were of opinion that the lands were too undulating; irrigation would not be able to reach them They did not think that these lands would not be irrigated if it were possible to irrigate them.

241. *Q.* The people would irrigate them in dry years. But in a series of years would they want irrigation such as they do for rice?—The yield can be improved every year by a watering in October.

242. *Q.* Do you think that as a famine protection it is as necessary to irrigate wheat lands as rice lands?—No. But we can considerably improve the wheat lands and get a better yield by irrigating them.

243. *Q.* Do you not find that in rice lands people are much more dependent on a single crop of rice than people in the wheat country on a single crop of wheat?—Yes, because in the wheat country they grow cotton and *juar* too. They have other crops.

244. *Q.* (*Mr. Muir-Mackenzie.*)—The bunded up fields under the *haveli* system are never fit for growing cotton?—I believe not. They don't grow the cotton and *juar* in the bunded fields.

245. *Q.* (*Mr. Craddock.*)—I understand you to say that you prefer to start irrigation works in rice tracts?—Yes. All the projects that we have taken up at present are confined to rice tracts. We examined only a few of the projects in Saugor outside the rice tracts to see what the storage would cost.

246 *Q.* In the rice tracts how would you work in with the existing system of irrigation. There is a lot of land irrigated, and very much of it is fairly irrigated under existing tanks. Will a man who has got a tank and spent a lot of money on it be willing to pay as much for the benefits of occasional irrigation as a man who has no irrigation now?—I think you will find that most of our projects are such as are necessary for feeding the existing tanks.

247. *Q.* Should you charge anything for feeding the tanks?—It depends upon the extent of our supply and the means of the man who owns the tank. We might not assess the land, but we might charge him for the amount of water that we give him.

248. *Q.* You must have a sort of commutation?—Yes, in cases like that, where a man had a scheme of his own. But in most of those cases, I think we should find that the works that we have designed will irrigate a sufficient area outside the area which is irrigated under the existing tanks.

249. *Q.* You said that the Ramtek project was a good one for an experiment?—Yes.

250. *Q.* Don't you think that it is too expensive for an experimental scheme?—I do not think that it is too expensive for a Government like that of India to test the capabilities of irrigation in the Province.

251. *Q.* The scheme costs about 10 lakhs. Is it not?—9¾ lakhs

252. *Q.* Don't you think it would be much better to put the 10 lakhs into rice country, where you have a sure and certain ground, and to put a much smaller sum into the wheat tract. So that if the experiment is a failure, you would not lose so much?—I think projects should be taken up first in rice tracts which need irrigation most. But it is also a very important question as to how far we should protect wheat areas; and if funds can be provided for the Ramtek project without retarding the construction of irrigation works in rice areas, I think it should be taken up. We have got large areas under *juar* and cotton which we cannot protect at all. How are we to arrive at any decision as to the best means of dealing with those areas without an experimental scheme?

253. *Q.* You are not asked to protect cotton and *juar*?—We might improve cotton. There is a certain class of cotton which might be improved, and *juar* may give way to other crops that can be irrigated.

254. *Q.* There are possibilities, but they are remote?—I do not know. Only the other day there was a person from Calcutta who was pushing the growth of cotton in this district. He was supplying seed in Raj-Nandgaon for cotton cultivation. He has already succeeded in getting some area under cotton cultivation.

255. *Q.* The chief thing that he is afraid of in Nawegaon is the damage by the excessive rain?—That is in regard to the present crop. You will admit there is cotton, which can be irrigated and which will be better than the one we are now growing.

256. *Q.* The difficulty is that our cotton and *juar* tracts and the low-lying land that you would be able to irrigate were absolutely secure in the year 1899 and they had very fair cotton?—There is no doubt that cotton and *juar* do not require protection and I do not advocate their irrigation. But I think it is possible that if facilities for irrigation are provided, a change of cropping may be effected and crops grown which can be irrigated.

257 *Q.* Where it does require irrigation is on slopes of hills where you can't irrigate?—Yes, on ridges and slopes of hills where it is stony. Cotton and *juar* do not need irrigation. But the question is whether we could not get a change of crop. Take the case of *juar*. It is sown in June or July and is reaped in December, so that only one *juar* crop can be got from the land, but with irrigation we can get two crops, you can get rice and wheat or gram. Which is more profitable—whether to allow the land to go on producing one crop of *juar* or to produce two crops—one of rice and one of wheat?

258. *Q.* If I may sum up your general conclusions—tell me whether I am correct or not—they are that you consider it as proved beyond demonstration that irrigation is possible and necessary in our rice tracts?—Very necessary.

259. *Q.* And that you think it highly probable that it will also be almost equally beneficial in our wheat tracts?—I should not say "almost equally." But I should say very beneficial outside *haveli* or bunded tracts which includes a system of irrigation.

260. *Q.* And that at present there is a great deal of doubt about cotton and *juar*, and that as regards those tracts you would like to see more experience gained?—Yes.

261. *Q.* You would not like to embark on large or expensive schemes in those other tracts?—I should prefer to see rice tracts taken up first. But I do not see why we should wait till all the rice tracts are taken up before constructing works to gain experience in other tracts.

262. *Q.* You would like to take up smaller works in wheat tracts, and if they are found successful, you would take up larger works?—Yes.

263. *Q.* (*The President.*)—I just wish to ask you one question. You have a great number of projects; if you were asked to select one out of them to be put into early execution, as an object lesson and an experiment, which would you recommend?—I would like to do it in consultation with the Revenue Officers; we should select a project which we know will be taken up willingly by the people and at once.

264. *Q.* On that point you would like to compare notes with and consult the Revenue Officers?—I would consult the Revenue Officers in regard to every project before I would recommend its commencement.

The Honourable Mr GANGADHAR RAO MADHO CHITNAVIS, C I E, Landowner.

(*Nagpur, 4th March 190*[illegible])

Mr. Gangadhar Rao Madho Chitnavis.

1. *Q*. (*The President.*)—You are a resident of Nagpur?—Yes.

2. *Q*. You own lands?—Yes; in four districts of this Province.

3. *Q*. Have you suffered much from famines?—More in the late famine than in that of 1896-97. I have a large number of villages in Bhandara and Chanda districts. That is the reason why I suffered most.

4. *Q*. With your knowledge of the Central Provinces and your own personal interest in the matter, it would be very useful for us to know what you think would be the right policy for Government to pursue to protect the country from the recurrence of such disasters as there have been?—I think if Government could build storage tanks whereby it would be possible to irrigate a large number of villages, that would enable Government to tide over difficulties *Takavi* loans also may be advanced on more liberal terms to cultivators and landlords.

5. *Q*. For what purpose?—For making small tanks in villages That would also go a long way to meet the difficulty. Thirdly, I would recommend assistance being given to tenants to enable cultivators to make embankments, because the greater the number of embankments that land has the less the number of bullocks that are required.

6. *Q*. For ploughing?—Yes.

7. *Q*. How do the banks save the bullocks? Because the ground becomes soft. In districts other than those where rice is cultivated, I would recommend that *takavi* may be given for sinking wells When applications are made for *takavi* professional advice as regards boring must be given by Government. I would also recommend that improvements should not be taxed as such.

8. *Q*. Never?—I would recommend that they should never be taxed, because these improvements secure the revenue to Government; whereas to the malguzars or the person who invests money, it is of course uncertain what he will have to pay by way of assessment. He has also to spend money for the repairs of these works. While he is held responsible for them, it is not certain whether the improvements he makes will always give him a sure return A well may be dug and it may fail and may not be successful.

(*Mr. Higham*)—In that case he would not be taxed?—But the people fear that he would be taxed.

9. *Q*. Are there any parts of the country where you would suggest large storage works and for what cultivation would you suggest them?—With regard to rice chiefly.

10. *Q*. In what part of the country do you think they would be most desirable?—I would recommend the construction of such storage tanks in Bhandara and Chanda. I have villages there.

11. *Q*. Do you know anything of Chhattisgarh?—I have not much knowledge of that part of the country

12. *Q*. You propose *takavi* advances being granted both for small tanks and works?—Yes.

13. *Q*. Do malguzars avail themselves of the *takavi* advances largely?—I have reasons to think so. I think in the famine of 1896-97, when Government was kind enough to advance money on a more liberal scale and promise them some remissions, more *takavi* was taken than at other times.

(*Mr. Craddock.*)—There was a good deal of what we have heard called patriarchal pressure.

(*The President.*)—With regard to smaller tanks that you were talking of, up to what size should they be done by private resources and when should the Government step in? Can it be that Government should step in when a tank is to irrigate 100 acres?—I do not think the Government ought to step in in regard to tanks at all. But in the case of tanks which may irrigate 10 to 20 villages the Government might come forward.

14. *Q*. Would you say 2,000 or 3,000 acres?—Yes, 3,000 or 4,000 acres.

15. *Q*. Do you think that up to that malguzars should do it?—Yes, I think so—malguzars and big tenants.

16. *Q*. It will cost a good deal of money?—If a grant-in-aid were given, I think they would embark on that enterprise after advice.

17. *Q*. A grant-in-aid of Rs. 20,000 and that kind of thing?—I think that for small tanks Rs. 5,000 or 6,000 each would be sufficient.

18. *Q*. As a loan?—Yes.

19. *Q*. When you say that you would not charge afterwards, do you mean that the man should have permanent settlement afterwards, or do you mean you could not charge him for the well? Suppose before he made the well he was charged dry rate and suppose that the dry rate was raised all round, would you not raise his dry rate?—Yes. The assessment charged on general considerations may be raised; but the improvements as such should not be charged.

20. *Q*. Always?—Yes, always.

21. *Q*. Would a malguzar understand it? Suppose when the settlement came round the officer said: I won't tax you for your tank, but I would tax you because the dry rate has been raised all round and you will have to pay Rs. 15 instead of Rs. 10. Would he understand the reason?—Some of them would understand it. They would compare their rates with those of the neighbouring fields and understand the difference.

22. *Q*. You would help the tenants to make embankments round the fields, *i.e.*, the *haveli* system?—Yes. In Paoni Chauras, in Bhandara, that system prevails.

23. *Q*. Could that be done all over the Central Provinces?—There are many people who understand the benefits of this system and are gradually taking to it.

24. *Q*. Do you think it would be good policy for Government officers to encourage it all through the country?—Yes. Wherever it is possible to do it, it would be advisable to encourage.

25. *Q*. Will you give us your views about the irrigation of black cotton soil?—For rice purposes, I think the black cotton soil, if irrigated, requires a larger amount of manure than yellow soil. Yellow soil is better adapted for rice than black cotton soil.

26. *Q*. Black cotton soil is best for *juar* and cotton?—Yes.

27. *Q*. Is it good for wheat?—Yes, wheat also.

28. *Q*. Do you think it is ever desirable to irrigate it?—From my own experience I say that it will be desirable if attempts were made to irrigate it. I know some tracts in Umrer Tahsil where I allowed spare water in my tank to wheat—water which remained after supplying the rice fields. In that case I had a better wheat crop than I could get in ordinary years.

29. *Q*. Suppose the Government had made a great number of tanks, would you try and encourage wheat cultivation under them if the soil is black cotton soil?—I am not very sure, because there is the fear of rust Sometimes it happens that there is a great deal of water, generally in the month of February, when the crops are exposed to rust. I am not sure if it will succeed.

30. *Q*. Do you know the Nerbudda valley, Hoshangabad and Narsinghpur?—No, not from personal experience.

(*Mr. Higham.*) I understand that you recommend that Government should undertake the construction of a storage work that would supply something like 20 villages?—Yes.

31. *Q*. What would you do in the case of works that would supply too much for one village and enough for two or three villages? Do you think that they should be done by Government?—I would recommend it in some cases, because it would not be possible for people of different villages to unite and combine together

32. *Q* Do you think that people of two villages would combine?—In many cases they may not combine. The principle of combination is not known to many people. If they combine, it is so much the better; but if they do not, I think the Government should come forward and help them in the matter.

33. *Q*. I see in a number of schemes worked out in the Public Works Department here, they generally regard the limits as 400 acres and anything below 400 acres is not considered. Do you think that is too small an area to undertake?—I think it is too small for Government to undertake.

34. *Q*. You think it is better if it is 2,000?—I should say a sufficiently large area.

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35. *Q.* Suppose a tank is made for a large area and is so designed that water can be guaranteed to the whole of the area marked out even in the driest years, what rate do you think people might be asked to pay for water?—I should recommend that if such storage tanks were made and if water is given to high level lands, to lands on higher levels where water from ordinary tanks cannot be provided, I believe Rs. 1-8-0 or Rs. 2 the people would willingly pay. But in the case of lands on a lower level, which can be watered by existing tanks, of course they would hesitate to pay at that rate as permanent charge.

36. *Q.* I am now speaking of rice cultivation?—Yes, I also speak of villages under rice cultivation.

37. *Q.* Would they be sure of getting water whenever there is a break in the rains? Would it not be worth something to them?—They would gladly pay any price for water if it is given to them in times of necessity.

38. *Q.* Suppose so much of land as is now irrigated by the ordinary tank is now assured a proper supply at all times, so that the owner could be sure that he would get water when wanted, what would he pay for it?—For lands which are situated at higher levels he would pay Rs. 1-8-0 or Rs. 2.

39. *Q.* For lands on a lower level?—For lands already under the tank irrigation, he might pay 12 annas per acre for an assured supply.

40. *Q.* You don't think they will pay more?—Yes; I don't think so.

41. *Q.* Not for the benefit of getting water whenever they want it?—They would not be inclined to pay.

42. *Q.* They would probably go on as they are on the chance of getting rains?—Yes.

43. *Q.* Do you recommend the making of storage works in tracts where rice is not cultivated?—I would rather hesitate to make any such recommendation.

44. *Q.* Why?—Because I am not sure whether people would care to irrigate their fields. I fear that in course of time rust may spoil the crops. There were some years, for instance, that last four or five years when irrigation would probably have done good to wheat.

45. *Q.* Suppose water-supply is given to places where *juar* and cotton and dry crops are cultivated and if a regular supply is given to black cotton soil, would they convert that cultivation into rice?—They would not, because cotton is more paying than rice.

46. *Q.* You mean that the profits of cultivation of cotton are more than the profits of cultivation of rice?—Yes.

47. *Q.* In spite of their having a failure of rains some years and losing their crops altogether?—Yes; they want very little rain for cotton, and when they get crops, they fetch higher prices than rice. They want more rain for rice than for cotton.

48. *Q.* In these cotton districts there was a great deal of distress during the late famine. Was there not?—There was, but not to that extent as it was in the rice-producing districts.

49. *Q.* You would not like a certain supply of irrigation introduced into that and cotton converted into rice?—I would not.

(*Mr. Muir-Mackenzie.*)—Are there a great many tanks in the villages which you own?—There are.

50. *Q.* Have you made any new tanks?—In 1896-97 I made two or three new tanks.

51. *Q.* As famine works?—More or less as famine works.

52. *Q.* Do you think you would have made them if it had not been for famine?—Not in that year.

53. *Q.* Had you made any new tanks before the famine came on?—Yes.

54. *Q.* Of how much use were the existing tanks to you in the famine of 1896-97?—They were of great use to me, because the supply of water in the months of June and July was much more in that year than what it was in the year 1899. Most of the tanks were filled to some extent and they could irrigate rice fields partly.

55. *Q.* Did you get as good a crop as in ordinary years?—Of course there was failure of crops, but not to the extent to what it was in 1899.

56. *Q.* Were people of your village on relief?—In that year fewer than 1899.

57. *Q.* You say that you would like *takavi* to be given on more liberal terms?—Yes.

58. *Q.* In what direction would you like more liberality?—I would recommend the giving of grant-in-aid. Where a person takes a *takavi* of Rs. 100, I would recommend that half of it should be remitted and the other half should be given on small interest as now. The period of repayment, *viz.*, 35 years is long enough, though those who take *takavi* are asked to repay it in a much shorter period.

59. *Q.* What is the usual period?—About 10 or 15 years.

60. *Q.* You would like the whole period to be given generally?—I would.

61. *Q.* Do you think that it would be a much prized inducement?—Yes; I should think so.

62. *Q.* Is there any other way that you could suggest?—I cannot suggest any other than what have already suggested.

63. *Q.* What would you like *takavi* to be given for?—For tanks, for embankments, and for wells.

64. *Q.* Is there much scope for wells?—Yes; in parts of the country where there is no rice cultivation. Where there are no tanks I believe people may take *takavi* for wells.

65. *Q.* But they would not take it in the rice country?—They would not care for it.

66. *Q.* In black cotton country or wheat country, would they take it?—They would.

67. *Q.* You don't think that wells would be of any assistance in a rice country?—I don't think so.

68. *Q.* Would not wells have given you water in 1899-1900 when tanks failed?—There are places in which wells failed.

69. *Q.* Did the wells fail completely in 1899-1900 like the tanks?—I think so. My experience shows that most of the wells failed and we had to dig them over again.

70. *Q.* By digging them over again you got some water?—Yes; but that was used for drinking purposes.

71. *Q.* If you had wells for irrigation and if they fail in a year of famine and if you dig them you could get some more water, whereas you could not do the same with tanks?—Yes; but what you get from a well is not enough for irrigation purposes in such a year, when soil soaks very much.

72. *Q.* Is there anything peculiar in the tract which accounts for it, because all over the famine area in other Presidencies they deepen wells to get water for irrigating crops which they could not have got in any other way? Is water very difficult to get in your particular district?—I do not know what the reason is. In cases where there were wells people did not report to them in 1899-1900. For irrigation purposes they did not think water sufficient and all that labour paying.

73. *Q.* Nobody tried to save his crop by means of wells?—Very few.

74. *Q.* You think it could not have been done?—I don't think that he could have found sufficient water.

(*Mr. Higham.*)—Do you think they would have found water in the wells for wheat?—In a year of scarcity when there is no water from the beginning, I think they would rather find it difficult to irrigate wheat.

(*Mr. Muir-Mackenzie.*)—You are a Mahratta Brahmin?—I am a Prabhu.

75. *Q.* Do you know any other parts of the Mahratta country or the Mahratta Deccan?—No.

76. *Q.* All over the Mahratta Deccan they build wells and get a great deal of crop?—I have got a village in Nasik district.

77. *Q.* Have you never heard of wells being dug and their getting crops?—I have never heard anything about it.

78. *Q.* Do you find that in a year when there is a great deal of rust there is any more on the embanked wheat fields than on other fields?—Sometimes. in the embanked fields; if there is too much rain there is rust.

79. *Q.* Embanking does not beat the rust?—I cannot give a very definite opinion on the matter.

80. *Q.* Do you think that if improvements were exempted from taxation, tenants would understand the fact of their exemption? When a revision of settlement occurs and there is an enhancement, on revision, of the tenant's rent for his whole holding, will he understand that the enhancement is less than it would otherwise have been in consequence of the improvements being exempted from taxation?—There are many tenants who compare the rates of assessment levied on different fields. There is one other matter which acts as discouragement to the taking of

takavi loans. They say that all durable improvements are to be exempted for one term of settlement. That leads to much wrangling as to what is durable and what is not durable.

81. *Q.* You think that distinction should be abolished?—Yes. In the case of poor cultivators if they make an embankment it is as much for his good as for the good of the whole community.

82. *Q.* Are there plenty of sites on which new tanks could be made?—There are some sites. I cannot answer that question.

83. *Q.* On account of small tanks in villages you don't think that all the best sites have been taken up? --If *takavi* were liberally advanced and encouragement were given in that way, many people would have small tanks to irrigate their fields.

84. *Q.* You don't think that all sites have been taken up?—There are some still remaining.

85. *Q.* Plenty?- I can't definitely say. There are some.

(*Mr. Rajaratna Mudaliar.*)—You just said that in case of improvements, which are not durable, the same concession should be granted as regards exemption as in the case of durable improvements? --Yes.

86. *Q.* You referred to field embankments?—Yes.

87. *Q.* How are they assessed?—If field embankments are constructed, they are classed as embanked lands.

88. *Q.* And assessed as dry?

(*Mr. Craddock.*)—They are classed as embanked Bandia if it is a small embankment, or Bandan if it is a big embankment.

(*Mr. Rajaratna Mudaliar.*)—Is there any limit as to the height of an embankment?

(*Mr. Craddock.*)—If you put up a big embankment, the increased rate should never exceed 25 per cent.

(*Mr. Rajaratna Mudaliar.*)—As regards *takavi* loans are they generally granted promptly or is there any delay?—It depends upon the officers.

89. *Q.* As a general rule?—In the late famine, of which I have a large experience, they were given very promptly.

90. *Q.* Because there was a special establishment? —Yes.

91. *Q.* But in ordinary times?—It takes some little time.

92. *Q.* What time does it generally take—a month or two—or what?—The Tahsildar has to make some inquiries. It all depends on the convenience of the Tahsildar who has to make inquiries. One Tahsildar may finish the inquiry in a month or he may have other work and may delay this.

93. *Q.* Do you think that if a special establishment were sanctioned for each taluk or group of taluks, it would facilitate the disbursing of loans; would it encourage people to take loans to a larger extent than now?—Yes, I think it is advisable to do so.

94. *Q.* What is the rule if the land is heavily mortgaged? Are loans granted or refused in such a case?—Whether the land is mortgaged or not, *takavi* is the first charge upon the land. The rights of the creditor are second to those of the Government.

95. *Q.* You mean that a Government loan takes precedence?—Yes.

96. *Q.* Do you think that leads the malguzar to interfere and object to the grant of loans?- I do not think so. In spite of it many loans have been taken.

97. *Q.* Do malguzars hold themselves responsible for the return of the loan?—Yes, sometimes, when they give consent.

98. *Q.* Are they required to sign any agreement holding themselves responsible?—No agreement is to be signed.

99. *Q.* Is the malguzar consulted in every case in which a tenant is given a loan?—Not necessarily consulted.

(*Mr. Muir-Mackenzie.*)—His consent is not required? —In some cases; in the case of occupancy rayats, his consent used to be taken before the new Tenancy Act came into force.

(*Mr. Rajaratna Mudaliar.*)—In the case of occupancy tenants, his consent would be immaterial?—The Government is at liberty to attach his land. Before the Act of 1899, no malguzar took objection to a tenant making improvements.

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100. *Q.* What suggestion would you make for encouraging a malguzar to construct more tanks?—I have stated them already. By giving more liberal *takavi.*

101. *Q.* Are there any concessions?—Of course if a malguzar is to make a tank for his people and if he were to promise that he would not charge anything for water, some concession by way of remitting a part of his revenue might be made.

102. *Q.* Why should he give water without payment, he himself having spent money on the tank? Why should he not charge a reasonable water-rate? The concession that I referred to is whether he may be given exemption from the enhancement of assessment for a term of years?—I would recommend that when he takes the initiative in constructing the tank and does not charge for water, some remission in his revenue might be given.

103. *Q.* Remission or exemption from enhancement?—Remission as well as exemption from enhancement.

104. *Q.* You would allow him to levy a water-rate and at the same time get his revenue remitted? Would that be fair?--That would not be fair. He should be allowed these concessions in consideration of his not realizing the water-rate.

105. *Q.* If exemption from enhancement alone be granted what period would you recommend?—For all time. Permanent exemption.

106. *Q.* On what grounds would you justify it?—I have stated the grounds already. He spends money, and considering vicissitude of seasons, and many liabilities such as repairs, etc, to which the improver makes himself subject, the sacrifice made by Government by such exemption will not be too much. It must also be noted that he thereby secures a larger share of Government revenue than his own share. This would also secure fully to people all benefits arising from the improvements on which they spend their money instead of keeping them under suspense that a large portion of the benefit arising out of such an improvement will be appropriated by Government after the settlement.

(*Mr. Craddock.*)--Do I understand you to say that you would not make any distinction between durable and other improvements and you would exempt *kachcha* wells for ever?—If it is used for irrigation purposes, I would.

107. *Q.* Very small embankments of which the cost could be repaid in a couple of years?- Embankments costing about Rs. 10 or so.

108. *Q.* The present limit is Rs. 50. Don't you consider that reasonable?—You may go lower down and make it Rs. 30 or Rs. 20. I don't think that Government would lose much and that would save them from making elaborate calculations.

109. *Q.* You would give exemption for ever from assessment on improvements?—Yes. That would encourage improvements.

110. *Q.* In the case of large tanks that irrigate 10 or 20 villages you would like the Government to undertake storage reservoirs, but in the case of a smaller tank you think that malguzars might carry it out themselves? I think so. They may be assisted with *takavi* loans for the purpose.

111. *Q.* You also state that there is a difficulty in getting people to combine. Do you think it is desirable to make a provision under the Land Acquisition Act by which land may be acquired for tanks?- Yes.

112. *Q.* I saw a case myself the other day. When they wanted to make a tank other men who owned the land would not give it on account of bad terms?—I have also a case on hand. I have a tank that I wanted to deepen. If it is deepened the water would spread over to another man's field, but he was not willing to give it. It is therefore impossible to deepen the tank.

113. *Q.* Do you think that there would be any hardship in allowing land to be acquired?—In some cases there will be harshness. But if it benefits a large number of rayats, the Deputy Commissioner may do it after consideration.

114. *Q.* Under proper safeguards you will then recommend it?—Yes.

115 *Q.* The reason why I asked you this is: one of the chief obstacles in the construction of tanks is the difficulty of getting the small area which a man commands?—Under certain safeguards I would recommend it.

Mr. F. G. Sly.

Note on irrigation by F. G. Sly, Esq., Commissioner of Settlements and Agriculture, Central Provinces.

(Nagpur, 5th March 1902.)

The information contained in this note is compiled from the official records of the Departments of Settlements, Land Records and Agriculture. My personal acquaintance with the districts of the Central Provinces is confined to 2½ years' service as Assistant Commissioner in the Sambalpur district, 1½ years' service in the same capacity and as Deputy Commissioner of Raipur, and 4 years' service as Settlement Officer of the Hoshangabad district.

Rainfall.

2. I attach a statement showing the average rainfall in each month during the past 32 years. This has been arranged into periods coinciding with the general agricultural operations of the Provinces. I also give the statistics of the two famine years, 1896-97 and 1899-1900, because in the consideration of irrigation matters it seems as important to know the minimum as the average rainfall.

Statistics of irrigation.

3. In a second statement I give statistics for the past ten years, showing for each district —

(*a*) the area of the principal irrigated crops;

(*b*) details of the sources of irrigation.

Division into tracts.

4. The agricultural conditions of the Central Provinces are very diversified, so that, in considering the question of irrigation, it is necessary to divide it into tracts having fairly homogeneous characteristics. For this purpose I accept the division made in Chief Secretary's letter No. 4938, dated the 3rd October 1901, which is as follows: —

(1) Chhattisgarh, with its rice cultivation and irrigation from tanks.

(2) The Wainganga valley, *i.e.*, Chanda, Bhandara, Balaghat and part of Seoni, where rice cultivation and irrigation from tanks is practised.

(3) The black cotton soil area, *i.e.*, Nagpur, Wardha and part of Chhindwara, where irrigation is almost unknown.

(4) The Nerbudda valley, *i.e.*, Nimar, Hoshangabad, Narsinghpur and part of Jubbulpore.

(5) The Satpura plateau, *i.e.*, Betul, the upper portion of Chhindwara and Seoni, in parts of which well-irrigation is already important.

(6) The rice tracts of Jubbulpore and Mandla.

(7) The districts of Saugor and Damoh.

Sparsity of population.

5. With the exception of some of the wilder hill tracts, included for the most part in zamindaris, I do not think that in any part of the Provinces there is any obstacle to the extension of irrigation arising from sparsity of population. A common opinion that the Central Provinces are very sparsely populated is hardly correct. It is true that owing to the enormous tracts covered by hills and uncultivable lands, the population per square mile is small, but in most districts the population per cultivated acre is fairly high and as dense as can be supported under the present conditions of agriculture. The rice-growing tracts undoubtedly offer the best field for irrigation, and these are the tracts most densely populated. In these tracts the only difficulty that I have ever heard of is an occasional shortness, more particularly since the last famine, of the casual labour required for transplanting rice. This operation must be completed within a short period, and requires many hands, so that a short labour supply is felt. But conditions soon adjust themselves, and if irrigation is available, there need be no fear that there will not be people to make use of it.

Supply of cattle.

6. There is an ample supply of cattle for the agricultural needs of the Provinces. Many districts still contain large stretches of forest and grazing lands where cattle are bred by professional breeders; a large number are also bred in almost every village; the northern districts adjoin the famous breeding grounds of Central India. Indeed, an opinion held by many Revenue Officers is that cattle are kept in numbers largely in excess of agricultural requirements, so that the village grazing grounds are over-stocked, resulting in a large half-starved herd instead of a smaller well-fed herd.

Supply of manure.

7. With a full population and ample cattle there should be no insufficiency of manure. And this is mostly the case in tracts where manure is valued, which are generally the irrigated rice tracts. The supply can largely be increased by more careful preparation and preservation, and the possibility of its profitable utilization will bring about this result. For instance, in wheat-growing tracts, manure is not generally used, and so is not preserved; in irrigated rice tracts, manure and refuse is more carefully preserved. Insufficiency of manure need not in these provinces deter irrigation.

Unsuitability of soil.

8. In considering this most important and difficult question, there is one principle upon which I place the greatest importance. This is that no irrigation scheme should be taken up in a tract where its utility cannot be justified by existing agricultural practice in that tract or in a tract with similar conditions. An examination of the irrigation statistics appended to this note will show that almost the whole of the area irrigated is rice, which is practically confined to Chhattisgarh and the Wainganga valley; that the irrigation of field crops grown in the black soil areas of Saugor, Damoh, the Nerbudda valley, the Plateau districts and the Nagpur country is infinitesimal; and, finally, that garden crops are irrigated to a small extent in most districts. There must be strong reasons for this glaring diversity of agricultural practice in regard to irrigation, and the conclusion to be drawn seems to me clear that irrigation is not profitable for black soil areas growing wheat, cotton and *juar*. I will deal with this question in more detail when I discuss each tract, so that it is sufficient here to emphasize the fact that there are large areas, almost wholly black soil, in which existing agricultural practice gives no encouragement to irrigation schemes. And Government should, in the first instance, confine its efforts to tracts where agricultural practice shows that irrigation will most certainly be profitably used if it is provided.

Uncertainty of the supply of water.

9. The agriculture of the Provinces is practically wholly dependent upon the rainfall of the year. The irrigated area is itself small save in the rice districts, and in those districts the sources of irrigation are dependent upon the monsoon rainfall. There are but few tanks in the Provinces which hold a sufficient supply of water to give irrigation in a year of rain failure. To cite an instance, only 50 tanks were used to irrigate 25,000 acres in 1899-1900 in the Chanda district, whereas in a normal year 5,877 tanks irrigate 145,000 acres. The few tanks which succeeded in 1899-1900 are mostly those fed from perennial springs issuing from the foot of hills. If complete protection is essential, the irrigation source must have a reserve supply sufficient to last over a year of drought, or must have feeders practically independent of the season's rainfall. I apprehend that few irrigation schemes will be found to fulfil these conditions, but this should not bar the undertaking of schemes which will save the crops in years of scanty rainfall, or in years when the rainfall is so badly distributed as to cause failure. A scheme which seems to have much promise is that canals or channels should be made to intercept the rainfall of a large catchment area or the water of rivers, and to lead it along ridges with branches to fill the tanks of the adjoining country.

Lack of capital.

10. The lack of capital is certainly one of the obstacles to the extension of irrigation. The owner of a village in which there is a good site for a tank has not the necessary means to make the tank; the tenant has not means to construct an expensive *pakka* well. Some suggestions for lessening this obstacle will be made later on.

Enhanced assessment.

11. The fear of an enhanced rent or revenue assessment has sometimes been stated to me to be the reason why facilities for irrigation are not made use of, and there seems some truth in this explanation. Under the existing rules (Revenue Book Circular I—13) all durable improvements to land are exempted from an enhancement of rent or revenue on that account at the next succeeding settlement, provided that the improvement is a substantial one, credit being ordinarily not given for a larger area than one acre for every Rs. 15 of outlay, though in special cases the minimum outlay per acre may be reduced to Rs. 12. In the case of specially costly works the period of exemption may be extended by the sanction of the Chief Commissioner on the representation either of the Deputy Commissioner of the district or the Settlement Officer engaged in its assessment. This exemp-

tion from an enhancement of revenue to the landowner is secured automatically for the remaining period of the current settlement, and by assessing at dry instead of wet rates at the next recurring settlement (Article 212, Settlement Code). Exemption from enhancement of rent on the ground of his improvements is secured to the tenant during the period of settlement by the provisions of the Tenancy Act, and by assessing at dry instead of wet rates at the next recurring settlement.

The encouragement of irrigation under native rulers.

12. Most of the tanks and other sources of irrigation date from the period of native rule, and there seems no doubt that the number constructed under British rule has decreased, although there are still many sites available. It will then be of interest to examine the methods by which native rulers stimulated the construction of irrigation works. Under Mahratta rule, the farmers of villages had no security of tenure, but they were not disturbed when they made substantial improvements. This inducement was removed by the British Government by the general conferral of proprietary right. The Mahratta ruler said: "Make a substantial tank, and I will give you security of tenure." The British Government said: "I give you security of tenure in the hope that you will now make a substantial tank in your own property." The gift has not been so successful as the promise. Under the Gond kings, great encouragement to tank construction was given by the grant of the land irrigated on a quit-rent known as a "tukam." The quit-rent was nominally fixed in perpetuity, but was in practice sometimes raised. The quit-rent was generally lower than the rent which would have been paid at dry rates, but the Government gained by obtaining the nucleus of stable cultivation for the establishment of a village in which cultivation spread to other dry land. This system was continued by the Mahrattas, and under it most of the large tanks of the Chanda district were constructed. It is for consideration whether a scheme could not be framed somewhat on the lines of this system.

Proposals for exemption from enhanced assessment of land improvement by irrigation.

13. The present rules give sufficient inducement for the construction of small works, but the terms might be made more liberal for large works. They are not understood by the people who are unable to distinguish between an enhancement of rent or revenue made on account of general considerations, such as the rise of prices, etc., and an enhancement made on account of improvements. For this reason I would suggest that no enhancement whatever should be made upon land substantially improved for a period of years fixed upon a sliding scale. Government may well forego for a fixed period of years any enhancement due upon general considerations where land is substantially improved. The period of settlement is an uncertain period, and has of late years tended to be short in these Provinces. It is not sufficient, as under the present rules, to allow the Deputy Commissioner or Settlement Officer to make a separate representation in the case of specially costly works; there should be a fixed scale which all may know. I would, as at present, fix a minimum limit that the exemption shall not be given for a larger area than one acre for every, say, Rs.15 of outlay. And I would then fix the period of exemption from *all* enhancement on a sliding scale of so many years for so many hundreds of rupees. An instance of such a scheme successfully worked is that known as the rules for the establishment of rice villages through a patel (Article 391, *et seq.*, of the Settlement Code). Under these rules a grant of waste land suitable for the formation of a rice village is made to a person willing to colonize it, on condition that he will construct a tank for irrigation. The revenue of the village is remitted for a period of years depending upon the amount of money expended on the tank, the following scale being in force:—

For Rs. 500 or less one year's remission for every Rs. 100.

Exceeding Rs. 500—

For the first Rs. 500 one year's remission for every Rs. 100.

Rs. 501 to Rs. 1,500 one year's remission for every Rs. 200.

Rs. 1,501 and over one year's remission for every Rs. 300.

Thus, for constructing a tank at a cost of Rs. 3,500, a remission of 17 years is given. At the end of the remission period, the village is regularly settled rayatwari, and the grantee is made watandari patel on a favourable rate of commission. This scheme has worked very successfully in districts where there are waste lands suitable for rice cultivation. The inducements offered include not only the remission but the opportunity of acquiring additional land in rayatwari right and the patelship of the village. I would suggest some similar scheme of exemption in malguzari villages. If the proprietor constructs a tank, the area irrigated by it should be marked off into a "tukam," the existing revenue determined, and an exemption from *all* enhancement of revenue granted for a period of years varying with the amount of the outlay. It might also be for consideration whether a further partial exemption should not be given for a second period of years; and, finally, whether a small exemption should not be granted in perpetuity. This would, undoubtedly, appeal to the feelings of the people, who draw a great distinction between an ordinary proprietor and a "maufidar"; no matter how small the money value of the *maufi* grant may be. For example, a perpetual grant at ⅛th *jama* would mean but little money loss to Government, but would be greatly prized by the receiver.

Land Improvement Loans.

14. I attach a statement showing the amount of the loans made under the Land Improvement Act during the last ten years. From this statement it will be seen that such loans are not freely taken, the sum advanced having been small, except during the famine of 1896-97. And during the past few years this form of loan has not been encouraged, because all the available funds have been required to meet the more urgent need for loans under the Agriculturists' Loans Act. The reasons which hinder landholders from making private irrigation works also deter them from taking loans, save that in the latter case the want of capital is removed. The cycle of bad years has also made many landholders hesitate before incurring additional liabilities for land improvement. But the main reason which makes these loans unpopular is the strictness of collection. A landholder will prefer to take a loan on a higher rate of interest from a money-lender, who will not press him for punctual re-payment, rather than to take a land improvement loan from Government which he knows must be repaid upon the dates fixed. It is not possible for Government to encourage carelessness in repayment, although a more liberal policy of suspension for good cause may have some effect. The present rules regarding the rates of interest are as follows:—

> Interest shall be charged on loans made under these rules at the rate of 6¼ per cent per annum Provided that if an instalment of principal or interest be not repaid on the date fixed, it shall be in the discretion of the Deputy Commissioner of the district to charge interest upon it at the rate of 12½ per cent per annum Provided also that the Chief Commissioner may, in special cases, sanction the grant of loans at a lower rate of interest or at no interest.
>
> "Interest on each loan shall ordinarily run from the date on which the loan was made. But with the sanction of the Commissioner, the running of interest may be delayed until a date which shall precede by at least six months the dates fixed for the re-payment of the first instalment of principal.

These rules are sufficiently liberal, and I do not think that any reduction of the rate of interest, which at present is below the local rates, would encourage the grant of these loans to landholders really requiring them for land improvement. Indeed, a reduction of interest would encourage a form of abuse, which at present is not unknown, of well-to-do capitalists taking a loan on the ostensible ground of land improvement, but really to obtain the use of cheap money. For similar reasons I would not recommend a remission of the interest. A partial remission of the advance might encourage these loans, but it seems open to strong objections as a regular practice. But I would grant a partial remission in case of failure of the attempt to obtain water. If the whole is remitted, there is the possibility that carelessness in construction may be encouraged, so that even in cases of total failure it might be advisable to collect a small sum in order to enforce responsibility. The rules regarding the period of re-payment are as follows:—

> The date of the first instalment shall not exceed three years from the date of the order granting the loan, and shall be fixed with reference to the time when the improvement will begin to yield a return. The date of the last instalment shall not in any case exceed 35 years from the date of the order granting the loan, and shall not exceed 15 years without the Commissioner's sanction.
>
> The amounts of the instalments may be so fixed as to increase with the productiveness of the improvement, or an arrangement may be made for the re-payment of interest and principal in consolidated sums after the fashion of an annuity."

These rules are sufficiently liberal as regards the period of re-payment. A grant-in-aid would not, in my opinion, do much to encourage these loans. This was tried in the first famine but largely failed, although this failure may perhaps be due to the fact that the loan was required to be spent on works managed on famine relief principles and not as an

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ordinary work. I have heard but very few complaints in these provinces that the whole amount of the loan does not reach the borrower without deduction; but in order to lessen the risk of this peculation, I would recommend that it should be an instruction, that so far as possible preliminary inquiries and the actual payment of the sum should be made by an officer not below the rank of Assistant Commissioner, and preferably on the spot whilst he is on tour. The rules themselves are sufficiently liberal, but they might in practice be more liberally interpreted.

Uncertainty of tenure.

15. The Tenancy Act of the Central Provinces leaves no uncertainty of tenure which can deter a landholder from constructing irrigation works. Indeed, the old feeling still survives from the times of native rule, that a landholder who makes permanent improvements is entitled to greater stability of tenure than one who does not. The legislation of 1898 removed the defect under which an ordinary tenant laboured in not being entitled to make improvements. The law also enforces the liability of a landlord to pay compensation for improvements to a tenant on ejectment.

Other obstacles to extension of irrigation.

16. There are some other obstacles to the construction of tanks, which are the most important form of irrigation works in these Provinces. Suitable sites for tanks may already be occupied by persons who are unwilling to give up or exchange their rights; a site suitable for the construction of a tank which will irrigate land in one village may be situated in another village or even in the Government forests; in some parts the holdings are so scattered that it is not worth the while of any individual holder to construct a tank which will command only a small portion of his own land. These and similar causes sometimes prevent the construction of tanks upon suitable sites.

Injury to remaining cultivation by extension of irrigation.

17. I do not think that the extension of irrigation tends to injure the remaining cultivation by attracting its cultivators to the irrigated tracts. On the contrary, there is sufficient population to cultivate any newly-irrigated land without disturbing old cultivation. In times of famine there is a tendency in rice districts for the cultivators to desert unirrigated *rabi* land and to congregate upon irrigated rice lands, but this is a temporary phase which soon rights itself; it is only an instance of the general principle that in years of scarcity the least profitable land is the first to go out of cultivation. Throughout the rice districts there is a very strong desire evinced by the people to have the means of irrigation extended. The cycle of uncertain seasons during the past decade has prominently brought home to them the necessity of irrigation for the security of rice cultivation.

Canals.

18. There are no canals in these Provinces, so that I am unable to give any information concerning canal irrigation.

19. Having thus endeavoured to deal with some of the general questions asked by the Irrigation Commission, it will be more convenient for me to consider the remaining questions in relation to the separate tracts referred to in paragraph 4 above, and I first take up—

CHHATTISGARH.

Although there are a few tracts in which *rabi* staples are grown, this tract is almost wholly a rice country, and any irrigation projects must mainly be directed to the irrigation of rice. In the following table I give some details of the average area irrigated for the six years 1890-91 to 1895-96. This period is taken by me because it shows the normal conditions prevailing prior to the famine years:—

Districts.	Net cropped area	Area under rice.	Total irrigated area.	Area of irrigated rice.	Percentage of cropped area irrigated.	Percentage of rice area irrigated.
1	2	3	4	5	6	7
	Acres	Acres	Acres	Acres.	Percentage.	Percentage.
Raipur .	2,224,553	1,306,003	25,768	19,180	1	1
Bilaspur .	1,208,648	832,562	31,071	28,453	2	3
Sambalpur .	596,703	303,003	28,583	23,250	5	6

Methods of irrigation.

20. Almost the whole of the irrigation is from tanks, which is not supplemented by irrigation from wells given to the same land. These tanks are filled by the surface drainage from the catchment area, which is very seldom increased by diverting water from a *nala*. The water is distributed by a direct cut in the embankment, which is annually made good again, the water being led along open earth channels to the fields at a lower level. There is not much loss from percolation through these channels, for they generally run through fields which are being irrigated. In years of ample rainfall the supply of water is sufficient for the area commanded, but in years of scanty rainfall the smaller tanks fail, the supply being used up for waterings in August—September, leaving no balance for the watering required by heavy rice in October. In years of drought all the tanks fail except the very few large ones. Experience shows that in a year of drought only the very largest projects succeed. The too late commencement of the supply may cause some damage, but not so much as the too early cessation, because the late monsoon rainfall is more precarious than the early falls. It is very essential for heavy rice to get water in October. Apart from the cost of constructing the tank, there is very little expenditure required to bring the water to the fields. The annual maintenance of *bunds* in the rice plots and the clearing of the water channels is a small matter. The available supply of manure is generally used for the irrigated plots. These expenses are incurred by the owners of the fields. As a general rule, the owner of the tank is responsible for its maintenance and repairs, but there is a general tendency for the malguzar to shirk this responsibility and endeavour to throw it on the tenants. The cost of ordinary maintenance does not exceed Rs. 10 a year for each tank; but if there is a break in the embankment, a good deal more has to be spent. Tanks are often kept in a bad state of repair, particularly where the owner has himself little or no land below the tank, because the owner will not do the repairs himself and will not let the tenants do it, under an impression that they may thereby acquire some definite rights in the tank. There is no need for legislation to remedy this defect, for action can be and is being taken under the conditions of the record-of-rights of each village. The distribution of water is arranged by the owner of the tank, supported or opposed by the general consensus of village opinion. In years of scanty rainfall this matter always gives rise to a large number of disputes, which are often settled by the revenue authorities. In the rare cases, where separate water-rates are charged by the owner of the tank, no difficulty is experienced in collection, for they are generally paid in kind at harvest. Some inconvenience is experienced from the liability of tanks to silt up, particularly where cultivation is carried on in the bed or catchment area of the tank. The depth of silt deposit depends upon the soil in which the catchment area is situated. It is not annually removed, its use as manure being very limited; but is allowed to accumulate until the efficiency of the tank is interfered with when it ought and sometimes is removed.

Extent of irrigation.

21. The statistics given above will show that the protected area forms a very small proportion, for which there are many reasons. The principal is that the holdings of cultivators are exceedingly scattered, each occupying many minute lots dotted all over the village. It is therefore not possible for any person to construct a tank which will command a sufficient quantity of his own land to justify the outlay, whilst common action by the village community is impracticable. Again, a tenant will often not give up the land best suited for making the tank. Further, the site suited for a tank may be in a village other than the village which would profit by its construction. All these reasons tend to deter private persons from constructing tanks even if they have the means and the desire to improve their cultivation. The area irrigated varies considerably from year to year, depending upon the seasonableness of the rainfall. There has been a considerable increase in the past six years when the rainfall has been uncertain. The maximum and minimum areas irrigated since 1890-91 are as follows:—

Districts.	MAXIMUM.		MINIMUM.	
	Year.	Area.	Year.	Area.
1	2	3	4	5
Raipur . . .	1896-97	62,027	1900-01	12,516
Bilaspur . . .	1896-97	76,863	1900-01	1,043
Sambalpur . .	1896-97	71,058	1900-01	5,453

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In 1896-97 the rainfall of the early monsoon was enough to fill the tanks, and these were used to the utmost with the complete cessation of rain in September. The conditions were very different in 1900-01; the monsoon was fairly suitable and there was little need for cutting the tanks. Again, the people had just come through a severe famine and had not the energy to push irrigation.

In the examination of these statistics there is an important consideration which must not be neglected. The areas shown as irrigated are those only to which water was actually given. They do not include areas benefited by percolation from the tank, which is the main purpose for which tanks are made in Chhattisgarh. Including this form of irrigation, an average tank will irrigate about 25 acres of land, whilst a good tank will irrigate about 100 acres.

Transplanting of rice.

22. Transplanting of rice is very seldom practised in Raipur or Bilaspur, whilst in Sambalpur only about 3 per cent. of the rice is transplanted. This may partly be due to want of knowledge and energy, but the local conditions have much influence. In unirrigated areas and with uncertain irrigation, it is very important that the crop should come to maturity before the rains cease. Transplanted rice ripens much later than rice sown broadcasted, so that it is necessary to use the latter method to secure a crop before the rains stop in October. With good irrigation, there can be little doubt that transplanting would become more popular.

Wet-rate assessment

23. *Q.* Under the present system of assessment, an addition to the rent of the cultivator is made for irrigated land. The area classed at settlement as "irrigable" is not the area actually irrigated, but the area irrigable, although in determining this area it is necessary, for caution, to confine the classification to land which has at one time or another been actually irrigated. This extra wet-rate is based upon a consideration of the advantages of irrigation judged by crop experiments, actual rents, and by the opinion of the people. But it is necessarily lower than a full water-rate, because allowance has to be made for the inferior sources of irrigation with an uncertain supply of water. This additional charge upon irrigable lands is, therefore, not a true measure of the value of irrigation, but it is a most important help in these provinces in determining the value of irrigation. Under the present system of fixing rents, this additional value of irrigable land is expressed by an addition to the number of soil-units used to represent the rental value of dry land. The difference between the soil-units fixed for irrigable land and for dry land multiplied by the prevailing unit-rate will give the additional rental at present imposed by Government upon irrigable lands. In the Raipur district the soil factors were increased for irrigability 50 per cent. in *kanhar* and *dorsa* soils, 66 per cent. in *matasi* soil, and 100 per cent. in *bhata* soil. Taking the average standard rate of the district, the extra rental value of irrigable land may be stated at 7 annas 2 pies per acre. In the Bilashpur district the percentage of increase varied from 39 per cent. in *kanhar* soil to 140 per cent. in *bhata* soil. The average additional rental value for irrigability in this district was about 6 annas 5 pies per acre.

Actual rents paid for irrigated land.

24. In these Provinces the proprietor of the land is usually the owner of the irrigation work, and the charge made for the use of water is included in the rent of the land. It is, therefore, very difficult to estimate what portion of the rent is for the use of the land and what portion for the use of the water. Again, rents are almost invariably fixed in a lump-sum upon the whole of the cultivator's holding, so that it cannot often be said what portion of it is paid for irrigated lands and what portion for unirrigated lands. I have endeavoured to compare some instances of the rent paid for irrigated lands with the rent paid for unirrigated lands; but the areas are so small that no reliable deductions can be made. In Chhattisgarh I have been unable to ascertain any rents paid separately for irrigated areas, except in case of small vegetable gardens, where the rents are often Rs. 3 to Rs. 10 per acre inclusive of the payments for land and water. This may be left out of consideration. It is also necessary to take into consideration the general level of rents, for, with a very low acreage rate like that prevalent in Chhattisgarh, there will be a greater disinclination to pay a water-rate largely in excess of the rent.

Water-rates.

25. In a very few cases irrigation works are owned by persons other than the proprietor of the land irrigated, where an actual charge is made for the use of water by the cultivator. This is a most important factor in determining a water-rate which Government might impose; but the instances which I have been able to discover are few. In Raipur there are a few cases in which payment is made for water to the owner of a tank. The water-rates run as high as Rs. 10 an acre for sugarcane; but for rice vary between 6 annas and Rs. 2 per acre. The area is small, but points to about Re. 1, being a fair water-rate for rice. In Bilaspur a rate of Rs. 2 is paid in one instance over a fair area.

These rates are paid for the area actually irrigated.

The yield of irrigated rice.

26. The standard outturn of rice in the Raipur and Bilaspur districts is 900 lbs. of unhusked rice per acre. This is probably too low for present considerations, when the catch-crops of rice raised on uplands may be neglected. For soils ordinarily brought under irrigation, the outturn of unirrigated rice may be put at 1,000 lbs. per acre, and of irrigated rice at 1,500 lbs per acre. This gives a value of 500 lbs., or, say, Rs. 6-4-0 for the irrigation. In Sambalpur the outturn of unirrigated rice is about 1,100 lbs. per acre, and of irrigated rice 1,700 lbs.; the value of irrigation is there Rs. 7-8-0. These figures may be taken as applicable to a year of normal rainfall. In a year of scanty rainfall the outturn of irrigated and unirrigated rice may be put at 400 lbs. and 1,400 lbs., respectively, whilst in a year of drought the yield of unirrigated rice will practically be *nil*, and of irrigated rice from 700 lbs. to 1,200 lbs., varying with the quality of the irrigation. These estimates are based upon an examination of the crop experiments.

Agricultural value of irrigation.

27. There can be no doubt of the great agricultural value of irrigation in the Chhattisgarh country. I have already stated how largely it increases the outturn of rice. This increase is not limited to years of deficient rainfall; but in every year irrigation is of value, for there is always some period during which irrigation is an advantage. One of the most important advantages of irrigation is that it permits of growing transplanted instead of broadcasted rice, resulting in a largely increased outturn with less seed-grain. Again, in unirrigated land, it is only possible to raise coarse varieties of rice which early come to maturity, whereas with irrigation the fine varieties of great value can be grown. Another most important advantage is that in irrigated land a second crop can often be raised. The system is somewhat peculiar; pulses or linseed are sown in the wet field, whilst the rice crop is still standing; the seed germinates in the wet bed, and after the cutting of the rice grows without any further irrigation. The yield of the second crop is not so large as if sown in fallow land; but it amounts to at least an average of 100 lbs. to the acre. To show how entirely double-cropping depends upon the rainfall and irrigation, it may be noted that the area under double-crops in Chhattisgarh fell to 66,327 acres in 1899-1900, whereas the normal area is 966,840 acres. Irrigation also gives to Government the greater security of the revenue and to the agriculturists the largely increased profits of greater stability of cultivation. The lands abandoned in the recent famines are the high-lying unirrigated fields, whilst the low-lying irrigated fields have continued to be cropped.

Recommendation for extension of irrigation.

28. For the above reasons I would strongly urge the advisability of an extension of irrigation in Chhattisgarh The soils are generally suited to irrigation, except the very heay black soil which lies in the valleys along the river banks. The tank system of irrigation is that most suited to the local conditions, and there is ample scope for its extension. The construction of tanks by private persons should be encouraged by more liberal terms in the matter of exemption from enhanced assessment, as recommended in paragraph 13 above, and by more liberal action under the Land Improvement Loans Act. There is also ample scope for the construction of irrigation reservoirs by Government, more particularly large works which are beyond the means of private persons. These should be extensive irrigation works which will prove effective in years of drought.

System of management suitable for Government irrigation works.

29. Any irrigation works that may be constructed by Government will, for the most part, take the form of reservoirs, from which water will be given by flow to the country below them. It seems, with works of the description indicated, there are practical difficulties to overcome before Government can charge for the actual amount of water used or at a fixed rate for each watering; the cost of maintaining an establishment for measuring the water taken by each cultivator, the number of waterings,

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or the area actually irrigated would, except in the case of large works, be practically prohibitive. I therefore suggest that a water-rate should be charged each year at a fixed rate over a fixed irrigable area, irrespective of the amount of water used. The rate must, therefore, be fixed lower than would be the case if it were only to be realizable upon the actual use of water.

Imposition of a water-rate.

30. A further question arises how Government can impose a fixed water-rate of this nature. I know of no legal power which the Central Provinces Administration possesses for imposing a water-rate without first obtaining the consent of the cultivator. At a revision of settlement Government has the power to fix rents, and might include in the rent the amount of water-rate which it thought fit to impose. But there seem to be objections to even this course, whilst the proprietor of the land would be entitled to his share of the rent. Section 13 of the Tenancy Act provides for the enhancement of rents on account of improvements made by the landlord; but there is no corresponding provision regarding improvements made by Government. Until the law is amended, the water-rate must then be so fixed that the cultivators and proprietors of the land concerned will agree with Government to contract for its payment. Section 157-A of the Land Revenue Act runs as follows:—

> "Rents, fees and royalties due to the Government for the use or occupation of land or water (whether the property of the Government or not) or on account of any products thereof, and all monies falling due to the Government under any grant, lease or contract which provides that they shall be so recoverable, may be recovered under this Act in the same manner as an arrear of land revenue."

I apprehend that under this section the rent due for the use of water must be *legally* due under some Act or under some grant, lease or contract to which the users of the water are a consenting party. Government must then obtain the consent of the users to the water-rates, and the rates must be sufficiently low to induce the users to give that consent. It will probably be necessary to amend the law by providing for the levy of water-rate on Government irrigation works.

Taking all the available information into consideration, it would seem that in Chhattisgarh a water-rate of Re. 1 per acre may safely be estimated at the commencement, which may be raised to Rs. 1-8-0 and then to Rs. 2, after the cultivators become accustomed to the payment and to the advantages of the water. It will be necessary to make an allowance to the proprietor for collecting the water-rate, which may be stated at 2 annas in the rupee.

Wainganga valley.

31. I now turn to the Waingauga valley, which contains the finest rice cultivation in the Provinces. There are some stretches of black soil devoted to *rabi* crops, which are seldom irrigated; but the main crop is rice, usually grown on yellow soil, or on an admixture of yellow and black soil. A fair proportion of the rice is already irrigated, and almost wholly from tanks. These tanks are much better than those usually found in Chhattisgarh, often having masonry sluices to regulate the supply of water. There are also some tanks which obtain their water-supply from perennial springs issuing from the foot of hills. Some of these seem to show great promise of being able to be largely increased, whilst some other similar sites might be found in Government forests. In regard to the system of management, etc., the remarks made about Chhattisgarh apply generally to the Wainganga valley.

Statistics of irrigation.

32. Figures for the portion of the Seoni district included in the Wainganga valley are not available; but the following statistics of the remaining three districts (excluding zamindaris) are of interest:—

Districts.	Net cropped area.	Area under rice.	Total irrigated area.	Area of irrigated rice.	Percentage of cropped area irrigated.	Percentage of rice area irrigated.
1	2	3	4	5	6	7
	Acres	Acres.	Acres	Acres	P. c.	P. c.
Balaghat .	314,731	244,887	78,690	75,615	25	32
Bhandara .	591,814	312,297	151,482	144,010	26	42
Chanda . .	643,953	186,365	146,670	139,900	3	76

In these districts the advantages of irrigation are fully appreciated, and there is no doubt that water, if supplied, would be freely taken. It is of more advantage to rice grown on yellow soil than on black soil, but irrigation on black soil gives the opportunity of raising a second crop. The rice is ordinarily transplanted, about 80 per cent. of the rice being so grown. The yield from transplanted rice largely exceeds that of broadcasted rice; the Settlement Officers of Balaghat and Seoni indeed estimate that it is about 50 per cent. larger. There is practically no year in which irrigation is not desirable for transplanted rice. The maximum and minimum irrigated areas are:—

Districts.	MAXIMUM		MINIMUM.	
	Year.	Area	Year.	Area.
1	2	3	4	5
		Acres.		Acres.
Balaghat .	1893-94 .	85,020	1899-1900	12,803
Bhandara .	1893-94 .	164,552	1899-1900	30,598
Chanda . .	1892-93 .	148,312	1899-1900	24,940

The irrigated area usually keeps fairly constant, the great drop in 1899-1900 being due to the failure of the water-supply in the tanks.

Wet rate assessment.

33. The excess wet-rate imposed at settlement was Re. 1-1-6 per acre in Balaghat, 15 annas in Bhandara, and 13½ annas in Seoni. The Chanda settlement has not yet been made, but the excess rate should approximate to that in Bhandara.

Water-rates.

34. There are a certain number of cases in these districts where a water-rate is paid to owners of tanks; but these rates are often paid in kind, sometimes only when water is actually taken and sometimes every year irrespective of the amount of water taken. From inquiries I find that in Bhandara the annual water-rate for rice may be as low as Re. 1, but is usually at least Rs. 2. Water-rates for rice run up as high as Rs. 6 to Rs. 10 per acre; but these are generally the survival of water-rates fixed for sugarcane, the cultivation of which has been given up.

In Chanda a common water-rate for rice is 1 *khandi* of grain for 1 *khandi* of land, which works out to Rs. 2 per acre. Cash rates vary from Re. 1 to Rs. 3 per irrigated acre. The differences in rent-rates are very striking in the rice tract, unirrigated non-rice land paying about 4 annas per acre, whilst irrigated rice land pays about Rs. 2 per acre. For sugarcane land, a general water-rate is Rs. 4-8-0 per irrigated acre, whilst it runs up as high as Rs. 6 and Rs. 10.

The yield of irrigated rice.

35. The standard outturns of rice are much higher than in Chhattisgarh owing to superior irrigation and methods of cultivation. They are:—

	lbs.
Balaghat	1,400
Seoni	1,200
Bhandara	1,500
Chanda	1,500

In Balaghat the Settlement Officer considers that the difference of outturn between irrigated and unirrigated rice is 1,210 and 1,585 lbs., whilst the Settlement Officer of Seoni gives it at 1,060 and 1,850 lbs. It may, I think, be safely put at an average of 1,100 and 1,700 lbs., which gives a profit of Rs. 7-8-0 for irrigation. In years of scanty rainfall the yields of unirrigated and irrigated rice will be about 600 and 1,600 lbs., respectively, whilst in a year of drought, unirrigated rice will yield nothing, whilst irrigated rice should give an outturn of 1,100 lbs.

Agricultural value of irrigation.

36. Apart from the increased outturn of irrigated rice, irrigation will lead to more transplanting which again increases the yield. A larger quantity of seed is required for transplanted areas and the cost of cultivation is greater, but this is small compared with the increased yield. Heavy varieties of high value will displace light varieties of small value. An extension of double-cropping will follow. The capacity for bearing a double-crop depends upon the character of the soil, for there must

generally be an admixture of black soil. Sometimes a second crop of rice is raised, but it is generally lac, peas or gram. Lac is generally sown before the rice is cut, whilst peas and gram are sown after the rice is cut. Land at present growing poor miscellaneous crops can, with irrigation, be put down to valuable heavy rice, raising the rent-rate from 4 annas to Rs. 2. For these reasons I would strongly advocate an extension of irrigation in the Wainganga valley. Taking all the circumstances into consideration, it would seem that a water-rate of Rs. 1-8-0 per acre might easily be taken upon rice, and that it might be raised in a few years to Rs. 2.

Nagpur and Wardha.

37. In the black soil areas of Nagpur and Wardha there is very little irrigation. The principal crops grown are cotton, *juari* and wheat. One side of Nagpur borders on the Wainganga valley, and in this tract there is some rice cultivation which is inferior to that of the Wainganga valley proper. The excess wet-rate imposed at settlement upon rice lands was 15 annas. The outturns of irrigated and unirrigated rice are estimated by the Settlement Officer at 1,600 and 1,280 lbs. in black soils, and 1,280 and 760 lbs. in red soils. The extra profit from irrigation may then be put at Rs. 7 per acre. In this tract the wet-rate might be fixed slightly lower than in the Wainganga valley proper. The statistics of the two districts are given below :—

Districts.	Net cropped area.	Area under rice.	Total irrigated area.	Area of irrigated rice.	Percentage of cropped area irrigated	Percentage of rice area irrigated.
1	2	3	4	5	6	7
	Acres.	Acres	Acres.	Acres.		
Nagpur .	1,236,345	33,333	23,467	13,281	3	40
Wardha .	927,077	5,063	2,725	7	...	...

In the true black soil area there is practically no irrigation. The crops of cotton and *juar* suffer more often from an excess of moisture in the retentive black soil than from any lack of it. Irrigation will, in my opinion, have little agricultural value, and I do not think that Government should extend it in this tract.

The Nerbudda valley.

38. The Nerbudda valley is another black soil tract, in which there is practically no irrigation. It is principally a *rabi* country, the principal crops being wheat and gram. The average agricultural statistics for the years 1890-91 to 1894-95 are as follows :—

Districts.	Cropped area.	Area under wheat and its mixtures.	Total area irrigated.
1	2	3	4
	Acres.	Acres.	Acres.
Jubbulpore . . .	1 071,108	445,384	2,631
Narsinghpur . . .	629,892	231,375	2,323
Hoshangabad . .	1,050,155	632,913	3,022

The amount of irrigation is infinitesimal, and is confined for the most part to small garden plots. There are practically no tanks, the irrigation being made from wells. This is strong evidence against the advantage of irrigation in this black soil area, for there are some sites in which tanks could advantageously be constructed, whilst irrigation could also be carried on from some of the streams. In the eastern portion of the valley many of the fields are embanked with substantial banks, which hold up the water during the rains. In these a first crop of rice is often taken; but irrigation is not required for it. This system of field embankments is a substitute for irrigation generally ensuring a moist field for the sowing of wheat. In the western portion of the valley the fields are not embanked, and a single crop is raised in the winter. There is a sharp division between the tract in which black soil fields are embanked and those in which they are not embanked. This difference of practice is marked by a difference in the consistency of the soil, the embanked areas having a soil of stiff clayey consistency, whilst the unembanked areas have a more friable soil. It is, therefore, a question for decision whether embankments can profitably be extended to the latter areas. Existing agricultural practice would seem to give a negative reply; but, on the other hand, it is confidently asserted by others that the difference of soil consistency is the consequence and not the cause of embanking. This is a question which the Agricultural Department should set itself to solve, and if it is found that field embankments can profitably be extended, land improvement loans should be freely given for this purpose. Apart from this system of *quasi*-irrigation, I do not think that efforts should be made to extend irrigation in the true black soil areas. Wells are impracticable, because the water is found at very great depth, and only *pakka* wells built at great expense will stand. In ordinary years the black soil retains sufficient moisture to grow *rabi* crops without any need for irrigation. In years when the cold-weather rain is sufficient, there is a strong opinion amongst the cultivators that irrigation does more harm than good by inducing rust. Too much weight should not be given to the experience of the past few years when the rainfall has been deficient, for in earlier periods more damage has been done by excessive moisture than by excessive drought. And it is impossible now to justify irrigation on any permanent change in the climate of this part. Moreover, a very much larger quantity of water is required for irrigation in black soil than in red soil. Irrigation without manure is not very profitable, and the Nerbudda valley cultivator has not as yet learned to use manure. The standard outturns average 600 lbs. for unirrigated and 1,000 lbs. for irrigated wheat; but I presume that the latter outturn is in manured fields. Over a series of years irrigated wheat will undoubtedly give large yields than unirrigated wheat; but the difference may not be so great as that shown above. It is a very doubtful experiment to undertake irrigation works in a tract where its utility cannot be justified by existing agricultural practice, and I would deprecate any Government measures to this end in the black soil of the Nerbudda valley. But there are some sandy stretches in the valley, principally along the banks of rivers, where irrigation can profitably be practised and where there is already some well-irrigation. In these stretches water is found within a reasonable depth of 10 to 20 feet, and where good irrigated crops of wheat and vegetables can be grown. I would encourage the construction of wells in such tracts by liberal land improvement loans.

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Nimar.

39. The Nimar district, although situated in the Nerbudda valley, has exceptional conditions which differentiate it from the districts higher up the valley. It has the lightest rainfall in the provinces, and in consequence the character of the cultivation changes, cotton and *juari* being the most important crops. The ordinary *kharif* cultivation is all dry, but alongside it is carried on a small amount of well-irrigated cultivation of wheat and garden crops. Well-irrigation is applied to some 13,000 acres, or about 2 per cent. of the cultivated area. This is most common in the centre of the Khandwa Tahsil, where water is obtained at an average depth of about 25 feet. I have never heard that the water obtained is saline. Wells are generally to be sunk through some rock, the cost varying from about Rs. 50 for a *kachcha* well to Rs. 400 for a *pakka* well. A well will irrigate from 3 to 8 acres. The extra wet-rate assessment imposed upon the area irrigable from a well varies from Re. 1 to Re. 1-13 an acre. Any extension of well-irrigation depends upon the character of the soil, for even in adjoining villages water may be found at a workable depth in one and at an unworkable depth in the other. The supply of water is mostly from percolation. The "mot" is the ordinary means used for raising water, and it is difficult to improve upon it at the average depth of the water. I am not in favour of the construction of wells by Government, for the people can themselves construct them at less cost. But I would give Government assistance in the shape of expert advice for the selection of suitable sites, trial boring, and the use of boring tools particularly for hard rock which is beyond the capacity of the cultivator. A small expert establishment should be placed under the Agricultural Department for employment on this duty. Their services should be placed at the disposal of cultivators, no fee being charged when their efforts are unsuccessful, but a small fee being paid for finding water at a workable depth. I would freely grant loans for well construction, payment being spread over a considerable number of years, and almost a total remission being given in case of failure. I would also grant exemption from all enhanced assessment for a fixed period of years varying with the outlay.

Opinion of the Settlement Officer, Nimar.

40. I reproduce below some extracts from the Final Settlement Report dealing with irrigation in the Nimar district.

Change in irrigation.

The irrigated area has increased by 16 per cent. during the term of settlement. The increase in itself is satisfactory, but though the irrigated area stood, at the last settlement, at only 3 per cent. of the cultivated area, it has failed to keep pace with general cultivation, and now stands at only 2 per cent.

On the average there are less than 16 acres of irrigated land to each village. In the two groups of old Nimar, which are now in the Harsud Tahsil, the average is only half an acre; in the Burhanpur Tahsil it is only 7½ acres; but in the Khandwa Tahsil it rises to nearly 20 acres. It is the centre of the Khandwa Tahsil which has the most irrigation; thus the average irrigated area to each village is—

In the	Khandwa	group	. . . 48	acres.
,, ,,	Pandhana	,,	. . . 30	,,
,, ,,	Gokalgaon	,,	. . . 23	,,
,, ,,	Barur	,,	. . . 21	,,

* * * *

Three methods of irrigation.

Irrigation is carried on—
(1) usually from wells,
(2) occasionally from channels,
(3) exceptionally from tanks

Tanks.

Gradual silting-up has been the chief change during the term of settlement in the very few tanks from which irrigation is carried on. The Lachhora lake at the north-west corner of the district is the only important irrigation tank. In the famine of 1816 numerous small tanks were constructed, but owing, presumably, to faults in the trap-rock on which they rested, the tanks hold little or no water. A few in the Kanapur-Beria Pargana near the Lachhora lake retain water, but they serve rather for watering cattle than for irrigation, and are steadily silting up. The whole area irrigated from tanks is less than 500 acres.

* * * *

Irrigation by channels

In the centre of the Khandwa Tahsil irrigation by channels is not uncommon. A dam of palm trunks and mud holds up the stream, and an earthen channel leads water into the fields which are to be irrigated. The holders of the field combine to set up the dam and repair the channel yearly.

* * * *

Irrigation from wells

Irrigation from wells is increasing. Unfaced (*kachcha*) wells cost only about Rs. 60 and last in the hard soil for a number of years before the crumbling of the rock makes it necessary to face them at a cost which, for ordinary good facing, runs up to Rs. 300.

In 1896 there were about five thousand wells in the district- 613 cut in the rock, 2,251 dug in the soil and lined with brick, and 2,103 merely *kachcha;* but of the whole number only two-thirds are in actual use for irrigation. Of the rest, some are falling into disuse, because the sides have caved in; some are simply used for drinking; and some are held in reserve to supplement the ordinary supply.

* * * *

Improvement of irrigation.

The first step towards encouraging irrigation is to avoid discouraging it by the imposition of heavy water-rates. It is hardly possible to consider the water-rates taken at the settlement as heavy.

The next step is to determine for what crops more water is wanted. Nimar has an excellent system of *kharif* cultivation, which decidedly ought not to be deserted for *rabi* cultivation. But it is desirable that a cultivator should be able to supplement a deficient monsoon by one timely watering of his *kharif* crops; and a water-supply is needed, which shall ordinarily serve for that corner of the holding on which valuable *rabi* or garden crops are grown, but shall also be sufficient in times of drought to save the *kharif*.

The third step is to take the line of least resistance by encouraging that form of irrigation to which the people are accustomed.

Advantages of wells.

For this reason preference should be given to wells. There may be, on the flanks of the Satpuras, practicable sites for tanks of the Lachhora type, but considerable difficulties would occur in introducing and regulating the water-supply among cultivators unused to the system. The one advantage which reservoirs, if good, would have over wells, is that they would not fail in dry years; but good reservoirs are expensive and apt to pay no interest. The Lachhora tank pays interest but on the cost of repairs only.

As a means of irrigation, channels are inferior to wells, because in a dry year water fails sooner in the streams than in the wells, and channel irrigation has inherent difficulties of organization from which well irrigation is free. It must not be inferred from the apparent ease, with which existing channel irrigation is distributed, that Government would find it easy to organize fresh channel irrigation. The friction in the existing schemes is inaudible, because the schemes are so small, being village concerns, indeed almost family concerns. Any new scheme must be worked out spontaneously, and Government can do little towards devising or facilitating it. It is true that Government did build two masonry dams on the river Abna: but such reservoirs silt up in time, and the observation and repair of isolated works of this kind is difficult. Wells, therefore, are the most practicable means of extending irrigation.

Difficulties.

They are not universally practicable; for instance, in the two adjoining villages of Gunjli and Ghosli, in the north-west of the Khandwa Tahsil, Gunjli has substantial irrigation and Ghosli has none; the reason alleged is that the black rock found in Ghosli defies blasting.

Suggestions.

Another drawback is that in dry years wells are apt to fail. But greater depth would often bring a sufficient supply of water. Government can facilitate well-sinking not only by easy loans but by introducing improved methods of rock blasting. The deepening of wells should be encouraged, and it may be found possible for Government, in the Public Works Department, to improve, by training or by example, the primitive methods of the men who now wander about sinking wells. Either Government employés, working at cost price for individual cultivators, could sink difficult wells by dynamite or other approved method and so create a demand for better work which the ordinary well-sinkers would have to meet, or some ordinary well-sinkers could be trained in improved methods at Government expense.

There was at the time of re-settlement a distinct movement for sinking wells: the dry seasons and possibly the exhortations of the district and settlement staffs had fostered the movement. At present the water-supply in most wells is barely sufficient in dry years for the *rabi* or garden crops which it usually waters, and the knowledge that all the water will be needed for ordinary purposes prevents the rayats from giving special waterings to their drooping *kharif* crops. Therefore deeper wells are needed in addition to new wells. The Chief Commissioner has already (in paragraph 7 of Resolution No. 399, dated the 23rd January 1897, on the Khandwa Tahsil Report) accepted the principle that the conversion of *kachcha* (unlined) wells into *pakka* (lined) wells may be accepted as an improvement involving the usual exemption from enhancement of water-rate, and the *sanads* issued for such conversions were popular. It is worth consideration whether substantial expenditure on deepening a well should not receive, as a matter of course, a certificate declaring any additional area thenceforward irrigated as exempt for the usual time.

Satpura plateau

41. The character of the soil varies largely in the Satpura plateau, tracts being found both of sandstone formation and of trap. There is a certain amount of irrigation from wells, which is more common in the sandy than in the black soil, but it is insignificant. Tanks are very uncommon The average irrigated area is about 9,000 acres in Betul and about 8,000 acres in Chhindwara. The principal crops irrigated are rice, sugarcane, and garden crops. Wells can readily be sunk over most of the plateau, the depth of water being usually 20 to 30 feet from the surface. Wells are fairly numerous, many having been sunk in old times for opium and sugarcane cultivation. With the stopping of opium cultivation and the decline of sugarcane, the importance of well-irrigation is not now so fully recognized as it was years ago. In Betul wells are common both in the sandstone and trap country. With a normal rainfall no

irrigation is necessary for *rabi* crops; but if the winter rains fail, a watering or two much improves the yield. In the case of wheat there is a risk of rust, and in the case of pulses of frost and cold mist, the damage from which is increased by irrigation. There is probably much scope for the extension of well-irrigation in the plateau districts, which the people may resort to more freely if the seasons continue unfavourable. I would encourage it by the same methods suggested for Nimar. The standard outturns of the Betul district are 620 lbs. for unirrigated unmanured wheat and 1,000 lbs. for irrigated manured wheat.

Opinion of Settlement Officer, Betul.

42. I reproduce some extracts from the Final Settlement Report of the Betul district which gives the opinion of Mr. B. P. Standen, I.C.S., C.I.E., on irrigation in that district :—

Irrigation of *rabi* crops.

With a normal rainfall no irrigation is necessary; but if the winter rains fail, a couple of waterings will vastly improve the crop, will in fact make all the difference between a bumper and a poor crop. No wells are sunk exclusively for the irrigation of *rabi* crops, and there are no irrigation tanks, but sufficient water for 5 or 6 acres of *rabi* land can sometimes be spared from the sugarcane well, and there are in a good many villages small streams which can be temporarily dammed and utilized for this purpose. There are also numbers of wells which were originally sunk for sugarcane cultivation, but have been abandoned because a sufficient supply of water was not found, and many of these hold enough water to irrigate a good many acres of *rabi*. The land record returns for the year 1896-97, in which the rains ceased in August, show only 5,616 acres of *rabi* crops irrigated, and the average area is only about 4,000 acres. The irrigation of *rabi* land occupies a few days only, and is often effected after the patwari has completed his annual field to field inspection, and it is probable that some irrigation does not appear in the village papers; but from what I have myself seen during village inspection, I should say that a large area of *rabi* crop, which could be conveniently watered, is left dry even in those years in which the event shows that irrigation would have been most beneficial.

Reasons why area of *rabi* crops irrigated is small.

In the case of land lying under wells, which are used for sugarcane cultivation, this is no doubt often due to want of bullocks, since the watering of a good sized cane garden needs all the labour of four bullocks; moreover, if the rains have been short, the cultivator may be unwilling to risk the depletion of his water-supply below the minimum required for his cane land. Then again, if the well be a deserted one, not used for sugarcane, it would generally be necessary for the cultivator to spend Rs. 15 or Rs. 20 on the leather bucket and rope and the staging and wheel on which it hangs. The use of stream water involves little or no expenditure, but it is not so much resorted to as it might be. The principal reason is, I think, that there is always a great risk in the case of gram, *masur* and *tiwara*, and in the case of wheat a smaller risk, but still a real riks, that irrigation may do more harm than good. The risk in the case of the pulses lies in the frequency of frost and cold mists (known as *dhow*), of which the injurious effect is heightened by the presence of much moisture in the soil, and which are always most liable to occur in valley bottoms. More frequently than not the pulses are damaged to some extent in one tract or another from these cold mists, and wheat often suffers in a less degree. In the case of wheat a further risk lies in the possibility that heavy winter rains may fall after the crop has been watered, and the excess of moisture may result in a kind of black rust known as "kani." I have seen an otherwise splendid crop ruined in this way. But the disease is not often seen.

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Sugarcane wells.

In some villages of the Multai Tahsil lying on the central trap plateau the subsoil water is very near the surface, and there are wells in which the hot-weather level of the water is not more than 8 or 10 feet below the surface. But the average hot-weather level of well-water in that part of the district is about 20 to 30 feet. Elsewhere the water is generally deeper, and wells of 50 to 60 feet are not uncommon. In the deep black soil of the 54 open villages round Betul and the few villages lying in the basins of excellent land round Atner and Bhaisdehi in the south of the Betul tahsil, as well as in the sandy villages on the north bank of the Bel, the depth of the soft soil makes it necessary to shore the well tube with brick. But in that part of the district where sugarcane is most largely grown, namely, the undulating trap plateau, the formation is such that durable wells can be made without the use of brick and lime. The sugarcane gardens are found in valleys, many of which are very narrow. The soil in the centre is fairly deep, but it becomes continually shallower as it approaches the hills on each side. As a rule there is not more than 8 or 9 feet of soil in the deepest parts, and at the foot of the surrounding slopes the bed rock or *muram* is scarcely covered. In such land it is usual to shore with unshaped stones from the hill side only so much of the shaft as passes through the black soil on the surface. The underlying *muram* or rock requires no support. The length of time for which a well of this kind will last depends principally on the nature of this substratum, known locally as "nio." A projecting ledge of the *muram* or rock is left in the shaft at the point where the black soil meets it, and the stones which support the walls of the upper part of the well tube rest thereon. If the material be not hard enough, the constant dripping of the water from the "mot" wears it away, and in 4 or 5 years the cultivator has to spend a few rupees in strengthening the threatened portion of the wall. In some wells the underlying rock is so hard that the wells require no attention for many years. Wells are now very rarely shored with timber, though judging from Mr. Ramsay's report such wells were common at settlement. The cost of digging a well depends on so many contingencies that it is difficult to estimate an average, but the maximum and minimum expenditure which is incurred in wells of the different classes and the circumstances which affect the cost may be stated. A durable bricked well in soft deep soil cannot be made for less than Rs. 100; and if the water be very deep and the shaft fall in once or twice before it can be supported with its brick tubings, the expenditure may amount to Rs. 400 or Rs. 500. The stoneshored wells of the Multai Tahsil can be made for Rs. 15 or Rs. 20 if the water be not more than 12 or 15 feet below the surface, and the underlying rock or *muram* be not excessively hard. I think the most expensive of these wells never costs more than Rs. 200. The pierce moderately hard rock the cultivators light a fire of cow-dung cakes on the rock, and when it is very hot, pour water on it, so that it cracks in all directions and is then broken up with crowbars. If it will not yield to this treatment, it is blasted with gunpowder. The earth and debris removed from the shaft is used to form an inclined plane called "dhao" on which the bullocks walk. This serves a double purpose. It lightens the labour of the cattle and enables the cultivator to raise the water to a level much higher than the mouth of the well, thus enabling him to irrigate a larger area. Sometimes, if it is desired to irrigate land lying at a considerably higher level than the well, the cultivator makes a hole (known as *bhurka*) at the highest level to which he can carry water from the well, and he fills the *bhurka* from the well, and then with help of another "dhao" raises the water to a level several feet higher than the mouth of the *bhurka*. By this duplex arrangement the water is sometimes raised as much as 20 feet above the level of the mouth of the well. Some more remarks on the subject of sugarcane wells will be found in Part II of this report in the paragraphs regarding the exemption of improvements from assessments. Experiments show that one man working with two pairs of bullocks one "mot" or leather bucket can raise about 66 tons of water in a working day of 10 hours from a well 30 to 35 feet deep.

Opinion of the Settlement Officer, Chhindwara.

43. Next I reproduce the remarks made in his Final Settlement Report by Mr. Montgomerie on irrigation in the Chhindwara district :—

Absence of irrigation.

The only crops which are irrigated in the district are vegetables, spices, and sugarcane. One exception—a very small exception—to this rule is wheat, but an irrigated wheat-field is as rare as a correct statement of *siwai* income. Fruit-trees also are watered.

It is natural that in the Chhindwara Tahsil irrigation should have made little progress, for the cultivator who desired a larger outturn simply took up more land from the cultivable waste. In the thickly populated tracts below the ghâts, irrigation might be expected to make progress; but the system of cultivation in which the cultivators of the Sausar Tahsil are skilful does not include irrigation, and the low countryman who wishes for a larger outturn increases the care paid to cultivating his existing fields, if he cannot get fresh land. Further the amount of water tapped by a well is said to be less below the ghâts

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than it is above the ghâts. Such irrigation as exists is carried on from wells, or in rare cases from water-holes (*bhurkas*) dug at the foot of a bank overhanging a stream. In either case the water is lifted in a circular leather bag (mot) attached by a rope running over a pulley to the yoke of a pair of oxen, which lift the water-bag as they pass down an inclined run, and return backwards up the slope when the water has been discharged. The discharging channel which receives the water commences just at the head of the inclined run, and leads the water off to one side. The main rope runs on a pulley over a bar fixed about four feet above the top of the run; an auxiliary rope runs over a roller fixed at the beginning of the discharging channel and is fastened to the mouth of a leather tube inserted at the bottom of the water bag. When the bag is ascending, descending, or stationary in the water, the auxiliary rope holds up the mouth of the leather tube, so that no water can escape from the bag; but when the bag is drawn right up to the pulley, the auxiliary rope at a lower level guides the mouth of the tube over the roller into the discharging channel and the water is free to rush out through the tube.

Irrigation by a channel led from a dam on a stream or from a tank is so rare that it is not worth consideration.

In no assessment group does the irrigated area amount to more than 2 per cent. of the total area. In the Chhindwara Tahsil the irrigated tract, starting at the west of the Samaswara group, extends along the top of the ghâts through the Chand and Mokher groups; half-way along the top of the ghâts it trends to the north-west and covers the open yellow soil villages on the west of the Chhindwara group and the east of the Umreth group. In the north-east tahsil, round about Amarwara Khas village, there is a cluster of villages in which irrigation for sugarcane prevails. Below the ghâts, in the Sausar Tahsil, the best irrigated tract is the Pandhurna valley, which includes the small Chicholi group and the centre of the Pandhurna group, and is, as regards soil, not unlike the irrigated tract above the ghâts. In the valley of the Jam river also there is a group of villages in which irrigation is practised.

Small as is the irrigated area, it has actually decreased since the last settlement, except in the villages of the yellow soil area west of Chhindwara town. The decrease is due to the decay of sugarcane growing.

The rice tracts of Jubbulpore and Mandla.

44. In Jubbulpore the rice tracts are mostly situated in the Murwara and the Sehora Tahsils. Rice is generally grown on sandy soil. It is practically all broadcasted and not irrigated. In Mandla rice is mostly grown in the sandy villages to the south, the rice on rich black soil being often swamped. There are few tanks, although the formation of the country does not seem unsuited to them. The rice is practically all broadcast and unirrigated. The irrigated area in Mandla has never exceeded 1,200 acres. Under such conditions the outturn is naturally low, being 850 lbs. per acre for each district. If irrigation works are started in these tracts, it is evident that for some years the water-rate must be pitched very low indeed until the cultivators are accustomed to irrigation and better methods of cultivation. I have no knowledge of these parts which would justify my expressing any opinion as to the possibilities of extending irrigation.

Saugor and Damoh.

45. The agricultural conditions of these two districts are very similar. They are both essentially wheat-growing tracts, wheat and its mixtures covering over 50 per cent. of the cropped area. The *rabi* crops are grown in black soil, regarding the irrigation of which my former remarks apply. For ten years prior to 1892 the *rabi* crops suffered almost continuously from excessive rainfall. In Saugor rice is mostly grown in small plots round the villages, which often bear a double crop. In Damoh rice is more largely grown in sandy valleys amongst the hills, where there may be scope for irrigation. In both districts it is practically all broadcast and unirrigated. The cultivation of sugarcane has declined, but for reasons other than those connected with irrigation. Irrigation is quite insignificant in both districts, the average being about 7,000 acres in Saugor and 2,500 acres in Damoh. The standard outturns of rice are 900 lbs. in Saugor and 800 lbs. in Damoh. The wheat outturns are 600 lbs. in Saugor and 500 lbs. in Damoh. It may be possible that there is scope for the extension of well-irrigation, but I have no knowledge of the tract.

(*The President.*)--I have to thank you, Mr. Sly, for the very interesting and full memorandum that you have submitted; it seems to embrace almost every subject that we have to deal with. In paragraph 8 of your memorandum you say that "irrigation is not profitable for black soil areas growing wheat, cotton and *juar*." This question has arisen wherever we have gone and it is a very important one. On page 19 of his note on the Hoshangabad district, Mr. Harriot says: "The malguzars were unanimous in their opinion that wheat on black cotton soil can be irrigated with advantage every year if the water is judiciously applied." Have you any remarks to offer on this opinion?—I know Hoshangabad very well. I may point out that the malguzars are of course an interested party; and if they can get Government to construct works for them that will be of use in years of drought, they may be prepared to express their belief in the possibility of continuous irrigation on back cotton soil. But look at their present practice; there are 300,000 acres of wheat in the district, and they themselves have never irrigated more than 2,700 acres, and of that 2,700 I know from personal experience that a large proportion is not in the black soil area, but in patches of sandy soil in the district; the actual amount of existing irrigation in Hoshangabad is quite infinitesimal.

1. *Q.* They might have irrigated more if they liked?—Yes, if it is really as profitable as they wish to make out, they should have done more.

2. *Q.* Were you here during the famine?--Not in 1896-97; I was in charge of the Feduatory States of these Provinces in 1899-1900.

3. *Q.* During these dry seasons has the irrigated area of Hoshangabad increased?—It has increased since the famine from 300 to 2,700 acres in Hoshangabad.

4. *Q.* When were these 300 acres irrigated?—In 1895-96.

5. *Q.* You say in paragraph 8—"In considering this most important and difficult question, there is one principle upon which I place the greatest importance. This is that no irrigation scheme should be taken up in a tract where its utility cannot be justified by existing agricultural practice in that tract or in a tract with similar conditions. I entirely endorse that as a general principle, but we have to consider the possibilities of protection against famine by means of irrigation?—Until the last seven years there has been very much greater damage and more famine in the black soil tracts by reason of excessive rainfall than by reason of drought.

6. *Q.* Could not that be prevented by efficient drainage?—I think not, with any reasonable prospect of success.

Mr. Muir-Mackenzie.—Is the crop of Hoshangabad principally *rabi*?--Almost wholly. Until the failures of the past five years it was principally wheat, but now they have partly abandoned wheat for gram and *kharif*.

The President.—If there had been a canal in Hoshangabad, do you think the people would have given up wheat?—I don't think they would.

Mr. Muir-Mackenzie.—Would they take water in a famine year?—Yes.

The President.—But not in an ordinary year?—I think in this Province the question of the irrigation of black soil is very largely dependent not so much upon the surface soil as upon the subsoil; if there is a good porous subsoil stratum it is possible that the soil may stand continuous irrigation. In Hoshangabad the black soil is deep and rests on a bed of stiff reddish clay, which is very impervious. I doubt if that would stand continuous irrigation, although it is exceptionally well drained on account of the unevenness of the country.

7. *Q.* The Nerbudda river now carries a large volume of water to the sea, and I should like to see it utilized. Can no use be made of it?—That is an engineering question; through Hoshangabad the Nerbudda runs between extremely deep banks and has a very slight fall.

8. *Q.* It probably would not be useful in Hoshangabad, but what about Nimar?—We have the same condtons there, with perhaps a more rocky channel.

9. *Q.* You say in paragraph 12 "most of the tanks and other sources of irrigation date from the period

of native rule and there seems no doubt that the number constructed under British rule has decreased, although there are still many sites available." Have no tanks been made by the British Government?—No, with one or two isolated exceptions in rayatwari villages. But in the late famines Government made many tanks.

10. *Q*. In paragraph 13 you suggest that "no enhancement whatever should be made upon land substantially improved for a period of years fixed upon a sliding scale." I understand you to mean that if a man, by taking a loan or otherwise, makes a tank or well, he should be allowed to go on paying exactly the same assessment on his land for a certain number of years, whatever the land has yielded?—I may explain that in the settlement you enhance the rate of rent and revenue of a village upon certain general considerations; if you allow a man's rent on that account to be enhanced, although his land has been improved, he cannot distinguish between the increase made in his assessment on general considerations and that made in his assessment on account of improvements. For instance, if land is paying say Re. 1 per acre, and at settlement it is considered that it might be enhanced for rise of prices, etc., to Rs. 1-8-0; if his improvement is estimated at 4 annas, the man's rent is fixed at Rs. 1-4-0 instead of Rs. 1-8-0. But the *rayat* does not realize that he has been let off 4 annas on account of his improvements; he considers that the rent on the land has been enhanced 4 annas on account of improvements effected by himself.

11. *Q*. You think it would be better to give him a fixed assessment for a certain number of years than to give him a perpetual exemption as is done in Bombay and Madras?—I think so; in these Provinces it would be an unnecessary sacrifice of Government revenue to give a perpetual exemption. But I would recommend a revision of the rules at present in force in those Provinces. In the first place, I would give an immediate remission on all lands submerged by works of improvement. In addition I would divide all improvement works into two classes: small works and large works; the dividing line might be drawn at works involving a capital expenditure of Rs. 500. For small works I think that our present rules which give an exemption for the next period of settlement are sufficiently liberal, and I would not change them for exemption for a fixed period of years, as this would create a large amount of trouble for small works with re-assessments continually falling in and necessitating inquiry by District Officers. But for large works I would be more liberal. If a malguzar constructs a large work, I would give him an immediate remission of one-eighth of the assessment on the land improved; I would give that remission for a fixed term of years varying with the amount of the capital expended, provided that the area is limited by a certain fixed outlay, say Rs. 12 per acre. I would give him seven-eighths of the existing *jama* for a fixed period of years on which no enhancement should be made; at the end of that period I am inclined to think it would pay Government to give him a perpetual exemption of one-eighth of the revenue then assessable on the land. That one-eighth would be loss to Government; but it would be a small item; and, on the other hand, there is a strong feeling amongst the people, which comes down from native rule, that a particular mark of Government favour in the shape of *muafi* grant of a fraction of the revenue has a great value, and this would be of more importance than any loss of revenue that would occur.

12. *Q*. Would you make it a condition that the descendant of the original *muafidar* should be bound to keep the work in order?—Yes; I would make it a condition that the ground on which the exemption is granted still exists and is in proper repair.

13. *Q*. There is also a suggestion that this concession should not be made saleable except under special condition?—I am not sure that I am quite in favour of putting in that condition; if a man has spent money on improvements, I think he should obtain the full advantage of it.

14. *Q*. You say there is a certain amount of prestige and dignity about being a *muafidar*; would that be sold too?—Yes; I would allow sale of muafi grants for improvements, although the majority of the *muafi* grants are inalienable in these Provinces.

15. *Q*. What is a *watandari* patel?—He is the managing headman of a rayatwari village who has been given perpetual rights of headship in that village with favourable rates of commission on collections; the ordinary patel may be dismissed at pleasure by Government for any particular reason.

16. *Q*. Is making him a *watandari* patel considered a compliment?—Yes; he is given *watandari* rights if he makes substantial improvements to a village, founds a new village or the like.

17. *Q*. Has a malguzar got the right to make a tank or *bund* in his own land whenever he pleases, or has he to go to the Revenue authorities?—If the land is in his own possession, he is entitled to do so; but if it is in the possession of a rayat under him, he cannot do so without the consent of the tenant.

18. *Q*. In any instance is the District Officer called in?—The District Officer is only called in in order to adjudicate; if a dispute arises between the tenant and malguzar in regard to the taking up of the land, then the District Officer can only exercise his executive influence to induce either party to come to an agreement.

19. *Q*. In many cases the water that fills a tank must be obtained from a catchment basin. As long as it comes to his land can the malguzar utilize the water and not pass it on?—Yes.

20. *Q*. I suppose you would say that for large tanks it would be better to have them the property of Government rather than private property?—If they are really large and substantial, I think it is necessary that Government should construct and manage them.

Mr. Muir-Mackenzie.—How large, tanks irrigating about 100 acres?—No, much larger; the limit would not depend so much on the area irrigated by the tanks as on the conditions under which the tank could be made; if a tank could be made wholly in one man's property and only irrigate that, I think he might make and manage a very large tank more profitably than Government could do it; but if it is in land held by several persons, it is better that Government should do it.

The President.—It would not often happen that a man would have ground to make a tank which could irrigate 500 or 1,000 acres?—Not now; sites have been exhausted.

21. *Q*. In the case more villages than one would be involved in the question?—Yes, and therefore it would be necessary for Government to manage it.

22. *Q*. Would you make it a rule forbidding the construction by a private person of tanks to water more than one village?—No; if a man is willing to make the tank, I would certainly let him do it; his self-interest would be sufficient to make him manage it so as to get the greatest profit out of it.

23. *Q*. I understand that the ordinary tank has deficient waste-weirs and is deficient in many respects?—In the Wainganga valley some tanks have masonry sluices; in Chhattisgarh I do not know of a single masonry sluice, as the tanks are made more for the purpose of irrigating by percolation and not for direct lead upon the lands. This is an important fact to remember in connection with the statistics showing the number of tanks and the amount of lands irrigated every year. The number of tanks is shown as fluctuating from year to year. Our statistics don't show the total number of tanks in a district, but the number of tanks actually opened out for irrigation in that particular year; in fact, in Chhattisgarh, in the best years when the tanks are beneficial a smaller number is shown. The same thing happens as regards the area irrigated; the land irrigated by percolation is not often returned as irrigated land at all, so that a year of best rainfall will show the least area under irrigated crops.

Mr. Higham.—When they make a field above the bund is that shown as irrigated?—No, only when water is taken to it by a channel.

The President.—As regards these tanks, by percolation does the wet area extend to any distance?—The average area in Chhattisgarh was put by me at 25 acres; other officers who have more experience of Chhattisgarh have put it at 40 and 50 acres.

24. *Q*. Do they work any larger area merely by percolation?—Yes; there are tanks working by percolation that will irrigate 400 to 500 acres; it is generally a narrow valley of which the head has been stopped by a *bund*. In the Wainganga valley they irrigate by means of channels; in Chhattisgarh they don't attempt to make the tank water-tight, but let the water percolate through the *bunds*.

Mr. Muir-Mackenzie.—Does the water flow along the surface of the fields?—It oozes from field to field; there is no perceptible flow.

The President.—Are these *bunds* pretty high, 20 feet or so?—Yes.

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25. *Q.* (*Mr. Muir-Mackenzie.*)—From Statement B I gather that you only record as an irrigation well a well from which irrigation was done during the year?—Yes.

26. *Q.* (*The President.*)—In paragraphs 27 and 28 you allude to the agricultural value of irrigation in the Chhattisgarh country. Mr. Higham and I have discussed this matter and we spoke of the advantages of starting as early as possible large reservoirs; it seems there are some excellently worked out projects in these Provinces. In what part of the country do you think it would be best to start construction? in Wainganga or Chhattisgarh?—The most important from a Government point of view would be Chhattisgarh, because it is not such a fully irrigated tract; it cannot stand famine as well as the Wainganga valley, and there are more important problems to solve there in connection with irrigation. There is one difficult question regarding which I have expressed an opinion in paragraph 26. In Chhattisgarh the whole of the rice at present grown is broadcast; we have to learn whether the reason is any inherent defect in the soil or whether it is purely and simply a question of the supply of water and energy on the part of the cultivators. There is one broad fact brought out by Mr. Fuller, which shows that the whole of the transplanted rice country in the Central Provinces is soil of crystalline formation and the whole of the broadcasted is sand-stone soil. Whether this accounts for the difference of practice has yet to be proved.

27. *Q.* Do you know any particular projects in Chhattisgarh to which you would give prominence?—No, I have not seen any of the projects.

28. *Q.* Would the Ramtek project be a good work in your opinion?—I don't know the country at all well, but I believe the black soil is upon a bed of laterite which is extremely porous; there seems no *primâ facie* reason why irrigation should not be successful.

29. *Q.* It seems from the technic[illegible] to present great advantages?—It is on the border line of rice cultivation; it is possible if irrigation was given there, that the rice cultivation of Bhandara would extend its limits into that country.

30. *Q.* Supposing Government created a new reservoir or tank and charged simply a water-rate per acre to every person who took water, I suppose there would be no question about their right to do that?—I think not.

31. *Q.* It might probably be easy to arrange with malguzars or owners of small tanks to supply water to their tanks at a certain rate?—Yes. Under Mr. Harriott's scheme, in which he propose to form Government works to fill small tanks, there will be some difficulty in deciding how Government is to obtain payment for the water that is given to the tanks; the only way in which Government can recoup itself for the expense is by fixing a lump rate of so many rupees for filling the tank and leaving the distribution and management to the owner of the tank.

32. *Q.* And leaving it to the option of the owner of the tank to buy the water or not?—Yes.

33. *Q.* You say at the end of paragraph 30: "It would seem that in Chhattisgarh a water-rate of Re. 1 per acre may safely be estimated at the commencement which may be raised to Rs. 1-8-0 and then to Rs. 2." We have discussed elsewhere the expediency of starting with low water-rates, and I think the feeling has been to fix full rates at once and make remissions for a certain number of years; would you agree to that?—I should like to know whether your question applies to water-rates at so much per acre or to a fixed rate year after year in addition to the assessment.

34. *Q.* The question arose chiefly in connection with water-rates in Northern India. That rate, I understand, would be optional; that is, it is only charged if the cultivator takes water?—Here I propose to have a fixed rate—a wet rate assessment which the cultivator would have to pay, whether he took water or not.

Mr. Muir-Mackenzie.—You don't think there would be any difficulty in recovering water-rates under the existing law?—No; please see paragraph 30 of my memorandum.

The President.—You say in paragraph 34 that the cultivation of sugarcane has decreased; is that generally the case?—Yes, throughout the Province.

35. *Q.* Why is that; it is a very valuable crop?—There are many reasons; the Province is being opened up by railways and there is the competition of imported *gur* from the North-Western Provinces and elsewhere, where it is made cheaper than in these Provinces. Then sugarcane cultivation is expensive and can only be taken up by a substantial man; perhaps the famine may have made it unpopular on that account. Cane requires also a good deal of wood and other forest material for fencing, etc., which perhaps people don't get as cheaply as they did in the old days.

36. *Q.* You allude in paragraph 38 to the Nerbudda valley; this is a tract, that suffered terribly in the famine?—It suffered very severely, but not as severely as other parts; Hoshangabad has an extremely bad record.

37. *Q.* The conclusion you have come to is that, as far as irrigation is concerned, nothing can be done there to help the situation?—I would not express myself so decidedly; irrigation in that tract should at present be confined, if it is started, to experimental measures—to see if the soil is suitable and whether it will take water continuously.

38. *Q.* There is another point on which I don't think we have got anything like satisfactory information; that is whether the lie of the country would admit of irrigation?—It is a rolling country and the rivers are very deep.

39. *Q.* Mr. Harriott's map shows a certain amount of rice cultivation above Hoshangabad?—Yes; along the bank of the Tawa river, there is some inferior broadcasted rice cultivation, it is merely a catch crop.

40. *Q.* In paragraph 39, referring to the Nimar district, you say—"I am not in favour of the construction of wells by Government, for the people can themselves construct them at less cost; but I would give Government assistance in the shape of expert advice for the selection of unsuitable sites, trial boring, and the use of boring tools." Is there much scope for the extension of well-irrigation throughout the Province generally?—I don't think so, but there are some tracts in the Province where *primâ facie* it seems that well-irrigation might profitably be carried on to a much larger extent than it is at present. Nimar is perhaps the most hopeful of the lot.

41. *Q.* Do the people take kindly to wells?—In Nimar they do. In the Nimar district there are 14,000 acres of well-irrigated land, which is much more than in any other part of the province; out of a total of 24,000 acres under wheat, 10,000 acres are irrigated from wells.

Mr. Muir-Mackenzie.—Not in black soil?—Yes, it is almost entirely black soil in the Nimar district, but not rich black soil

Mr. Craddock.—Is it not the case that in Nimar black soil will not produce wheat without irrigation?—Yes, almost entirely.

42. *Q.* (*The President.*)—If the Deputy Commissioner of Nimar was authorized to give freely *takavi* grants, would there be a rush for them?—I think so and a considerable extension of wells; in Nimar the cultivators are men of good means and of distinctly good character who would be prepared to improve their lands and who would have the energy to take advantage of wells if they were made.

43. *Q.* We have been met by the difficulty that the district officers have not the time to attend to giving advances, and it has been recommended that there should be a special establishment for the purpose. Would you advocate that?—In cases where there seems a probability of a large number of applications being received, I think it would be worth while to put an officer on special duty to encourage them and to deal with applications on the spot so as to get rid of a considerable amount of delay which does occur, our present staff having to do the work in addition to their own duties.

44. *Q.* All things considered, from your knowledge of these Provinces, what measures do you think should be taken to protect them from another famine?—Extension of irrigation, more particularly in the rice tracts, both by Government construction of large works and by the encouragement of the construction of small works by the people themselves.

45. *Q.* What is required for the black cotton soil tracts? Could anything be done there? They suffered less from famine than the rest of the tracts perhaps. In Nagpur and Wardha I very much doubt whether irrigation is possible and I don't think there is any other alternative that can be suggested; in the northern part of the Province the question of irrigation is perhaps more an open one, but even putting that aside there is the possibility of extending the system of bunding wheat fields. That is a question on which it is difficult to give a definite answer

but there is the broad fact that at present the system of bunding wheat fields exists in three or four separate parts of the Province; it is marked out by well-defined limits, inside which you will find the majority of the fields bunded and outside none; why the system is not universal it is difficult to say. Mr. Harriott says it has extended in the Saugor district and also in Hoshangabad; my own belief based on my experience about six years ago and on what I have heard from the people since, is that the amount of bunding Hoshangabad is practically nothing, I think you might count the number of bunded fields on the fingers of both hands. Whether it is possible to extend it profitably it is difficult to decide. Past practice would seem to say no. There is a distinct difference in the soils in the areas where *bunds* exist and where they don't exist; in the bunded fields the soil is distinctly more tenacious and of a more sticky nature, and holds well in *bunds*; in the unbunded parts the soil is friable and the *bunds* won't stand. Amalgūzar in Nagpur tried it outside the bunded area, but failed as the *bund* would not stand. Mr. Harriott thinks that where bunding is profitably carried out, it would be profitable to have irrigation. I am not sure that this is a sound conclusion, for bunding is very much more than irrigation; it amounts to flooding the field practically through the whole of the rains; it therefore largely aids the disintegration of the soil and increases fertility without ploughing; it does away with the necessity for all monsoon preparation of the land; it kills the weeds and the land is ready for the crop without any previous preparation at all; the field gets all the nitrogen brought down by the rainfall. The only conclusion in favour of irrigation that you can draw from the analogy of the bunded system is that it is an advantage to have a wet seed bed in October to put your wheat in. In handed fields there is more liability to rust in damp years than in unbunded fields.

46. *Q.* As regards wells, would you advocate their extension?—Wells in the Norbudda valley except in Nimar are very deep; the soil is such that the well must be made *pakka* at considerable cost. I am not very sanguine that there will be much extension in that tract.

47. *Q.* What about Saugor and Damoh?—I know very little about those parts.

48. *Q.* (*Mr. Higham.*)—You say in paragraph 13—"The terms might be made more liberal for large works." Is there any difficulty in the case of fairly large works in obtaining the consent of all the persons concerned, supposing the work was for more than one village?—Yes, for large works that extend over more than one village, it would be difficult to get them to combine.

49. *Q.* Do you think that any kind of legislation is necessary or desirable to overcome that difficulty?—I would legislate to permit the acquisition of land by private persons for the construction of an irrigation work that was approved by Government.

50. *Q.* Would that be a special Act or would it be an amendment of the present Act?—It would either be an amendment of the Land Acquisition Act or a clause in any special Irrigation Act that might be passed for this Province.

51. *Q.* I suppose there would be some charges for the use of water to cover maintenance and repairs, etc.?—I don't think it would be advisable for Government to legislate to enforce payment to owners of private works of water-rates; at present it is managed by the owner of a tank in accordance with village custom, which he is obliged to respect. There are not many complaints about difficulties in regard to management.

52. *Q.* Then it is only necessary to take power for acquiring land?—Yes; for the construction of tanks and for water channels which it would be necessary to make.

53. *Q.* I suppose it would only be necessary to acquire the right to occupy these lands and not expropriate the owners. Under the Land Acquisition Act you have to transfer the title?—Perhaps the people might like it better if you acquire only the right of occupancy.

54. *Q.* In the Punjab when land is taken up for a water-course merely the right-of-way is acquired through the land, for which compensation is paid. If the water-course is not used for 3 years the right lapses and the land reverts to the owner?—I think that arrangement would be quite sufficient in this Province.

55. *Q.* With reference to the proposals in paragraph 13, to give exemption for a series of years from increase of revenue, what will happen if works are not kept in an efficient state of repair?—There should be a condition attaching to the exemption that if a work fails, owing to want of repair or any other reason, exemption shall immediately cease.

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56. *Q.* It seems to me that in these parts when you have a succession of good years, these means of irrigation are apt to fall into disuse?—I don't think that is the case. I have never known a case where a tank has been allowed to go into disrepair, because it is not used for purposes of irrigation in good years; if it has gone out of repair it is owing to its not being useful, or it has failed in the object for which it was made or perhaps the owner has become impoverished and unable to meet the large expense required for keeping it up. As a matter of fact, most tanks in these Provinces are used every year for irrigation to the fullest extent possible. The fluctuations shown in the statistics are due not wholly to actual fluctuation in the areas irrigated, but to our method of records in the matter of percolation.

57. *Q.* What is the limit for which you may expect private owners to make tanks; would they work up to 500 acres?—Probably 500 is an outside limit.

58. *Q.* For anything beyond that it would be good for Government to make the tank?—Yes, particularly if the area extended over more than one village. There are very few places in this Province in which it would be possible to make a new tank that would irrigate 500 acres in any single man's property.

59. *Q.* The difficulties you refer to in paragraph 16 I suppose would be almost entirely met by the legis- works that are capable of being constructed by the lation you have just referred to?—Yes, for irrigation people and are more or less confined to the property of a single owner; but that would not meet the case of large irrigation tanks, which Government must step in and make.

60. *Q.* In paragraph 30 you say—"I know of no legal power which the Central Provinces possesses for imposing a water-rate without first obtaining the consent of the cultivators. There is nothing to prevent a water-rate being imposed under the Northern India Canals Act (VIII of 1873), which applies to the Central Provinces?—Under that Act you can only impose a water-rate for lands that are actually irrigated.

61. *Q.* The original idea was to impose in addition to that a compulsory insurance rate to be paid for all lands irrigable by the works. The Secretary of State refused to sanction a compulsory rate. You can only now charge a water-rate on land actually irrigated in any year. There is nothing in the Act saying that water-rate can be charged only with the consent of the owner, but there is no difficulty in Northern India. A man cannot get water on his field without some action of his own. In Bengal no charge can be made for water unless you have an application in writing beforehand. Since that Act applies to the Central Provinces it would be possible for you to introduce a water-rate omitting the wet-rate that you are now contemplating?—Yes.

62. *Q.* You could impose certain water-rates without asking for anybody's consent by a notification of the Local Administration; not the fixed rate you contemplate, but could you not compound for a fixed rate on a lower scale?—I think that could be done.

63. *Q.* If they declined to compound you could enforce the higher rate?—Yes.

64. *Q.* Do you think they would generally prefer to compound or stick out?—They would prefer to compound.

65. *Q.* That would get over the difficulty?—The difficulty that would occur is that in Government making a number of tanks which are comparatively small irrigation works, they are to charge a rate on the area irrigated each year, the expense of establishment would be very high.

66. *Q.* I agree that the other system is better. I suppose it would be quite possible to amend that Act so as to empower the levy of a water-rate of the kind contemplated by you?—I think so.

67. *Q.* That course was objected to by the Secretary of State in Northern India, but that was because there was no restriction; in this case you only take power to impose a rate on a defined area to which you would practically guarantee protection?—Yes

68. *Q.* I don't see why you require to enter into an agreement with cultivators?—Not if we have legal power outside the agreement.

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69. *Q.* In the same paragraph you say—"It would seem that in Chhattisgarh a water-rate of Re. 1 per acre may safely be estimated at the commencement, which may be raised to Rs. 1-8-0 and then to Rs. 2." Would you in that case set forth that you intended to work up to Rs. 2 ?—Yes.

70. *Q.* It seems to me that the allowance for collecting the water-rate of 2 annas in the rupee is extremely high ? It is the ordinary rate of allowance given to the malguzar in these Provinces for the collection on behalf of Government of dues payable by persons other than himself in his village.

71. *Q.* In Northern India we allow the heads of villages 3 per cent. and many people have thought that too high?—I suppose much depends on the amount of the assessment.

Mr. Rajaratna Mudaliar.—In Madras we allow 10 per cent.

72. *Q.* (*Mr. Higham.*)—From your remarks I infer that you are not in favour of the Ramtek project being taken in hand ?—I am in favour of its being taken in hand as an experimental measure to see the value of irrigation in black soil, on condition that the money applied to it is not withdrawn from more certain and more favourable schemes in the rice country. If the Government of India are prepared to provide funds outside their ordinary grant for the Ramtek scheme, it would be very advisable to take it up; if it means the postponement of other works in the rice country, I would not advocate it.

73. *Q.* There would be no difficulty in providings money if the work is likely to pay as well as is anticipated in Mr. Harriott's note? Do you think that estimate too sanguine ?—I have never seen the estimate.

74. *Q.* Speaking of irrigation works in the Nerbudda district you would only propose irrigation works there as an experimental measure in black soil. There must be places in which a permanent supply of water is available; it is a question whether a certain area might not be put under irrigation by means of steam pumps or lift, thus avoiding the heavy capital expenditure. The objection to a pump is that it involves heavy annual charges, but that expenditure would vary with the demand for water, if there was no demand the pumps could be utilized elsewhere; another point is that when water has to be pumped extreme care is taken to secure economical distribution. Thus if sites were suitable pumping installations might be useful?—I am not an Engineer, but it seems to me that the country does not lend itself to any large canal scheme. The only possibility for gravitation works would be to have reservoirs in the smaller streams running out of the Satpura hills with short canal channels along the ridges to the Nerbudda. I should like to see a steam-pump tried as an experimental measure, and it could be easily worked from one of the rivers.

Mr. Muir-Mackenzie.—There is one discrepancy between your return and Mr. Harriott's; take the district of Jubbulpore. The rainfall in the driest year is put by Mr. Harriott at 13 :39 you show it in 1899-1900 as 36·90 ?—I did not attempt to take out the driest year—I merely gave the returns for the two famine years. My statement does not pretend to show the driest year of rainfall.

75. *Q.* In the statistics of tanks and wells I find the increase of durable wells is fairly continuous all the way through; are the figures correct or are they vitiated like the tank statistics? No, well is recorded as an irrigation well unless it has been used for irrigation in that year; these statistics show clearly that year after year more wells are being used for irrigation; whether they are old wells or new wells that have since been constructed for purposes of irrigation the figures would not show.

76 *Q.* Then we may take it that, as these statistics show, there has been a considerable increase in the use of wells throughout the Province as a whole; and that the increase is not confined to certain divisions. Would you not say from that that some encouragement might be given to the extension of wells even in Chhattisgarh ?—It might be worth while to encourage the construction of wells in Chhattisgarh for the irrigation of crops other than rice.

77. *Q.* Is the small amount of well irrigation in these tracts due to backwardness and want of enterprise on the part of the population ?—I doubt if you can put that forward as a general conclusion; if that were so you would see instances of the more enterprising cultivators taking to well irrigation in advance of their fellows, but that is not the case.

78. *Q.* Do you think the country is as fully developed in Chhattisgarh as in Nerbudda ?—No.

79. *Q.* Is there not a large area of cultivable waste in the Province ?—No; the limit of profitable cultivation has been reached in the majority of the districts.

80. *Q.* Do you not think that the backwardness of the Province generally is due to the fact that there has been so much land for the people to get that there has been no pressure on it ?—Yes; I would like to qualify the statement made in the fifth paragraph of my note that there has been no obstacle to the extension of irrigation arising from sparsity of population. I think in the past it has been a distinct obstacle to irrigation. With an increase of population the cultivator must either extend his holding or cultivate more intensively. Until recent years there has been sufficient land for him to extend his cultivation without going in for more intensive cultivation. I think this still applies to the plateau districts and the wider parts of the Province, but not now to the more fully populated rice tracts. In the Wainganga valley and in Chhattisgarh the pressure of population on the land has been sufficient to induce the people to take up all methods of profitable irrigation within their means.

81. *Q.* How long has this condition obtained on the Wainganga and its Chattisgarh?—Within a period of, say, 15 years.

82. *Q.* The pressure is only just beginning?—Yes, and the pressure has been made more acute by the long series of bad seasons that have followed. A man may have a holding of 10 to 20 acres which supported him in former times, but it will not do so in bad years and he is consequently much more keen on irrigation at the present time than ever before. There is a distinct feeling among the people that it is now necessary to go in for more irrigation than formerly.

83. *Q.* Your view as regards the best protective measures in these tracts is the construction of large works by Government with an assured storage supply ?—Yes.

84. *Q.* In the next place, you would encourage the digging of smaller tanks ?—Yes.

85. *Q.* Would not all these tanks fail in a year of drought?—Not all; it would be possible to get a certain number of tanks that would carry through a year of drought, and if they failed there are years of comparative drought in which it makes all the difference between a famine and a fair crop.

86. *Q.* Would 1896-97 be an example of such a year ?—It was more than a year of comparative drought; even in that year the existing tanks did enormous benefit and saved a great deal of crop that would have been lost.

87. *Q.* Did they cause less need for relief in Chhattisgarh than in other divisions?—I cannot say, I was not here, but it is on record that they did.

88. *Q.* *Mr. Craddock.*—They required very much less relief in Chhattisgarh in 1896-97 as compared with 1899-1900. In the Wainganga valley there was practically no relief required in 1896-97; it was confined to the non-tank portion in Balaghat and Bhandara ?—In Chhattisgarh tank irrigation is insignificant, but I heard from the Settlement Officer that wherever they had tanks it made all the difference.

Mr. Muir-Mackenzie.—Generally all over the Province in 1899-1900 these tanks irrigated a very small area?—Yes.

89. *Q.* Must we not come to the conclusion that the great majority of the tanks would hold no water and be of no use in a year like that?—Yes, but they are of the greatest value in a year which just falls short of that.

90. *Q.* Would it not be better to trust to wells from a protective point of view? Would they not hold water in the worst year?—Well irrigation in these Provinces for rice cultivation is almost impracticable; the present agricultural practice in these Provinces shows that well irrigation for rice is not carried out at all.

91. *Q.* The general rule is that their tanks have been full?—Even in years when tanks have not been full they never resorted to wells.

92. *Q.* Their tanks have always been full, except in 1899-1900, when they proved a broken reed; did that year stimulate them to use wells?—No.

93. *Q.* The experience of one year was not sufficient to teach them a lesson?—No; the possibility of well irrigation for rice is extremely small.

94. *Q.* Just over the border, in Hyderabad, there is a great deal of rice irrigation from wells?—It would be necessary to find out the conditions prevailing there. The crops may be heavier and more valuable; there may be much less depth of water.

95. *Q.* If you say that the depth of water is too great or that the wells give out I can understand it, but they seem to hold water when tanks do not, and so I do not understand the despondent view you take?—I have not examined the statistics very well, but I think you will find that the depth of water in Chhattisgarh is pretty considerable.

96. *Q.* Is there any reliable information as to the depth of subsoil water in the different parts of the Province?—I don't think so.

97. *Q.* Would it be worth while to have a systematic examination made?—I think it would be very useful.

98. *Q.* If it were found that watetr was available for large tracts of Chhattisgarh within easy reach of the surface, would you take an equally despondent view as to well irrigation?—I am inclined to think I would. I think it would be impossible to induce the people to lift water for rice.

99. *Q.* In Chhattisgarh would the people not be inclined to make wells in the area outside tanks?—They have not done so in the past.

100. *Q.* Would you not like to see wells under the *ayakat* of tanks, so that when tanks fail they might give one or two waterings and thus save the crops at the end of the year?—I am not sure that a well underneath a tank would hold very much water. In connection with this question, I may point out that in certain rice districts, more particularly in Sambalpur, well irrigation is not unknown; it is practised for sugarcane cultivation as far as I remember.

101. *Q.* Only for sugarcane and not for rice?—Yes. They use it for sugarcane cultivation, which pays them. But they do not use it for rice. If it were profitable why don't they use it?

102. *Q.* It may be possible that it has not occurred to them. In Madras there are thousands of wells under tanks for this very purpose?—I do not know the conditions under which well irrigation is used for rice in Madras. I should imagine that it is a very much better kind of cultivation than the rice in the Central Provinces, which, perhaps, may account for its being profitable to raise water from wells.

103. *Q.* Do you think, judging from the rates in Madras, it is possible that the outturn here may be such as to make it profitable to use wells?—I doubt if it would be possible.

104. *Q.* Is the rice under tanks transplanted?—In the Wainganga valley the whole of it is transplanted.

105. *Q.* In Chhattisgarh?—Only about 5 per cent.

Mr. Rajaratna Mudaliar.—It is precisely the same system that is followed there and it is in reference to such crops that well irrigation applies.

Mr. Muir-Mackenzie.—Suppose you had a few thousands of rupees placed at your command, would you not be inclined to encourage these experiments?—I will be quite pleased to do it. If it is practised in other parts successfully, we ought to try and see if it cannot be done here.

106. *Q.* Have you had any work in the distribution of *takavi?*—Not for many years.

107. *Q.* From your Statement E, I should gather that the amount of *takavi* that is generally distributed in this Province is decidedly small. The largest amount given for land improvement is in the year 1896-97 when it was 2½ lakhs. In some of our Bombay districts even before the famine we gave out as much as 1½ lakhs a year.

The President.—In one district?

Mr. Muir-Mackenzie.—Yes, in the Carnatic district. In one district in a division we gave Rs. 25,000 a year. Even if there had been no Irrigation Commission, we hoped to have increased the amount. Don't you think there is room for large extension?—Yes.

108. *Q.* Do you think that if you had a larger amount at your command more could be distributed?—Yes.

109. *Q.* Has there ever been any shortage of allotment? Have you ever been unable to obtain the full allotment?—As I understand the position of this Province, the whole of the money available in the shape of loans in recent years has been given—it is more profitably spent—in seed loans to cultivators.

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110. *Q.* That is in famine years?—Every year during the last 4 or 5 years.

111. *Q.* You can't speak of the time before that?—I cannot.

112. *Q.* Can you tell me whether the practice of embanking wheat fields has been extending or contracting in recent years?—I believe Mr. Harriott says that there is a tendency to extend it in Saugor. That is the only part that I know where it has been extended.

113. *Q.* You don't think that if money were liberally placed at your disposal, it would be considerably extended?—It is very doubtful whether it could be considerably extended. One is not sure of the conditions suitable for embankment.

114. *Q.* If you had larger sums placed at your disposal for *takavi*, how would you spend it; would you spend it almost all on tanks?—I would spend it, firstly, on tanks and, secondly, on bunding wheat fields in tracts where it is at present successfully carried out.

115. *Q.* On wells?—Yes, particularly in Nimar.

116. *Q.* Are there any other districts, in which it can be done successfully?—Wells might be possible and advances for wells might be given in some of the plateau districts, more particularly in Betul, which has a certain amount of well irrigation.

117. *Q.* You say that if exemption of improvements from taxation were allowed, of improvements only, people would not generally understand its effects. Mr. Chitnavis said yesterday that people were beginning to compare the assessments of different holdings and they were beginning to understand a good deal about it. Do you think there is any truth in that?—It may be possibly true so far as the more intelligent and larger landowners are concerned.

118. *Q.* A malguzar would at any rate understand it?—Some might.

119. *Q.* Not the generality?—The generality would not. Not one in a thousand would understand it.

120. *Q.* How much of your advances is given for land improvement?—A very small percentage.

121. *Q.* Do you think that any misapprehension of the system stands in the way of your giving advances. You don't think that there is any special difficulty in making advances to tenants?—No.

122. *Q.* The amount that is given to different classes of holders is limited by rules. For instance, to an ordinary tenant you do not give more than three times the rent?—I do not think that is quite a correct statement. The rule provides that the amount of loan must be covered by the value of the interest in the land possessed either by the person applying for the loan or by persons who have given security for him.

123. *Q.* Then it would be possible to give him more than a certain multiple?—The question of multiple occurs only in a case where the person applying for the loan has himself no interest in the land to offer it as security, but offers as collateral security the lands of other tenants.

Mr. Craddock.—The rule is: "When the person making the applications for the loans has no interest in land to offer as security, a loan may be made on the joint personal security of not less than three occupancy tenants. Provided that the total amount of any loan made under this rule shall not, without the sanction of the Commissioner, exceed three times the total annual rental paid by such tenants on their land held in occupancy right. For loans made under this rule a bond in Form E shall be taken from the persons giving security."

Mr. Muir-Mackenzie.—One of the reasons for the delay in the disposal of applications is the necessity for inquiring as to security?—Yes.

124. *Q.* That is the principal reason you think?—There are two reasons of equal importance: first, the inquiry into the security; second, the inquiry into the necessity for, and the value of, the improvement.

125. *Q.* Do you think it is necessary to inquire into the value of the improvement, if you know that the man is going to spend the money for the purpose for which it is given?—Not as largely as it is done at present. As far as I know, the present custom is: papers are sent to subordinate revenue officials who have to go to the spot and personally inquire whether the improvement is an advisable one and whether the man is likely to spend the money for the purpose for which it is given and whether the security that he gives is sufficient. As far as I know, practically there is a local inquiry in the village.

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126. *Q.* Under your plan for exemption of improvements, which you stated in answer to the President, and in which you said that you would have more liberal terms given for large works, you draw the line at works costing Rs. 500. If that be carried out, I am afraid wells would practically escape exemption?—They would escape exemption under the more liberal rules recommended by me for large works, but would be exempted as small works under the existing rules.

127. *Q.* Don't you think that it is worth while to protect wells by exemptions?—The present terms are not illiberal, and I do not know that they are not sufficient.

128. *Q.* What you are anxious to do is to get small people to dig wells as protection against famine?—The question does not enter into the case of a man digging a well as much as the case in which a man digs a tank, because the man that makes a well makes it purely for the benefit of his own land from which he expects direct profit from increased cultivation under that well; but a man who makes a tank makes it, generally speaking, not only for the purposes of irrigating his own land, but also for irrigating the land of his tenants or of other people. He does not get such a large return from his tank work as that which the other man would get from his well.

129. *Q.* Does he not dig the tank in expectation of increased rents?—He does get increased rents, but that is a very small share of the increased produce that results from irrigation.

130. *Q.* Is there any chance of making a tank if there is no chance of getting a fair return?—I think that a majority of the tanks in the Central Provinces have been made quite as much from motives of charit and pressure of public opinion as for material profit.

131. *Q.* That is the ground on which you would hope for considerable extension in future—charity?—Now-a-days the benefits of irrigation from tanks are very much better appreciated than they were formerly. The motive of charity is one of the reasons why I thought that there would be a charm in turning all of them into *muafidars*, as it would appeal to the religious element rather than the element of gain.

132. *Q.* Another reason that you gave for not extending this exemption to a smaller class of improvements, was that a great deal of trouble would be entailed in the matter of making settlements. I do not quite understand what trouble would arise?—In a particular district that comes under settlement, the Settlement Officer has to fix the rental value of the land. If there is an exemption for a period of years the rental value has to the altered at the end of that period, so that the Deputy Commissioner would continually have to deal with cases in which the exemption period has expired and in which it is necessary to give notice to people and inform them that the rent has gone up.

133. *Q.* There is that same sort of trouble in anything that you give exemption for at the end of the next settlement?—No. That works automatically at each settlement. When a new settlement is made the Settlement Officer settles it straight away. Suppose there is a small holding the rental value of which is Rs. 10, but on account of improvement it is fixed at Rs. 8 for a period of 5 years after the fixation. At the end of those 5 years, the Deputy Commissioner will have to get the register of these exemptions and serve notice to the party concerned that his rent has now been increased from Rs. 8 to 10. If these cases become numerous, they cause a great deal of trouble. Directly you go in for fixed periods of years, which keep continually varying, you will have cases continually cropping up, from year to year, of exemptions running out and full assessments being due.

134. *Q.* How the thing is worked in the Punjab is that they do not give exemption as you propose, but they exempt them from enhancement for a fixed period which might terminate at the next settlement. Do you think such a thing is workable? Do you think that mere trouble should prevent you from giving them exemption, if the grant of such exemption would induce them to make improvements?—I do not think that mere trouble would be a sufficient reason. That is only a subsidiary reason; my main reason is that the present rules are quite liberal enough for small works and the period of exemption granted under the present rules is quite a sufficient recognition, and is not an insufficient motive for one to undertake them. But in a case where a man has to make large works and incur a deal of expenditure, not for his own immediate benefit, I think he is deterred by the question of assessment.

135. *Q.* I see that in these late years, the number of *kachcha* or non-durable wells has contributed a good deal to irrigation. Where these wells made in fairly large numbers in consequence of famine with the hopes of having a catch crop or fodder crop?—I cannot say. I was not here during the famine. As far as I know there was no particular tract in the Province in which there was any extraordinary extension of well irrigation during the famine. My own personal experience after the famine goes to show that small numbers of wells were made throughout all the districts rather than there being a special impetus given to their construction in any particular tract.

136. *Q.* It has been brought out, I think, that in practice the period of repayment for *takavi* seldom exceeds 15 years. Do you think that state of things ought to be altered and the period of repayment should generally be made as nearly equal as possible to the full period of 35 years?—In particular cases I think the discretion given by the rules might be more liberally worked, but I do not think that there will be any large advantage arising from a general lengthening of the time.

137. *Q.* Don't you think that people would be more ready to take loans if they are permitted to repay them in a longer period?—No, except for large loans for large works. The general wish of the cultivator is to try and repay the loan in as short a period as he can.

138. *Q.* Mr. Chitnovis and a malguzar, whom we heard, favoured long periods?—I have not heard much complaint from tenants about the period.

139. *Q.* With reference to the obstacles to extension of irrigation mentioned in paragraph 16, you don't mention the obstacle that is met with elsewhere; that is, people lower down an irrigation system objecting to the allocation of water to the people above them without even the ground that their own supply is diminished, but simply on the dog in the-manger system and on the ground that the only people that have a right to the water are themselves, and no outsider has any right to receive it. Is there any such obstruction occurring? It does. I have heard of it, but not in numerous cases. In Chhattisgarh, more particularly where the "tar" system has been introduced they object to let the channels be made across the villages.

140. *Q.* Would you kindly describe the "tar" system?—As far as I have seen it, it consists generally of a *bund* across the head of a *nala*, which catches the water at a fairly high level whence it is taken by a plain earthen channel along a ridge as high as possible and as far as the water will run and the fields are irrigated on both sides.

141. *Q.* Are these bunds thrown up fresh every year or are they permanent?—They are thrown up every year.

142. *Q.* You don't think that it would be necessary for Government to acquire rights over water in the same way as they acquire rights over land, so that they may control the distribution of water?—I think not. As far as I know in this Province, the Government has already got a right over water in navigable streams and rivers. There is some section in the Land Revenue Act about it. As for the control of water-supply in tanks and in drainage areas my belief is that any interference by legislation would do much more harm than good by helping to break up and throw into confusion the system which is at present very well managed by village custom.

143. *Q.* All the village customs are recorded in Wajib-ul-arz?—Yes.

144. *Q.* In what way can you enforce a custom?—Under the Land Revenue Act, under which a custom can be notified by the Deputy Commissioner, and if a person breaks that custom he is liable to be punished with a fine.

145. *Q.* The existence of that provision is sufficient to see the custom enforced?—Yes.

146. *Q.* I gather that there are plenty of sites available for new tanks?—Yes.

117. *Q.* For private tanks?—Yes.

148. *Q.* Do you think that it would do good if any sort of survey is made or if the people receive some assistance from the Public Works Department as to where they should construct their tanks?—Yes, for large works the Public Works Department may give very valuable assistance. But in the case of small village tanks I do not know if the assistance of the Public Works Department would be of great benefit.

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149. *Q.* If a man is going to spend as much as Rs. 1,000, do you think it is worth while to give him that assistance?—If he got expert advice from an irrigation Engineer, I think it would probably be useful.

150. *Q.* But what about such expert advice as could be given by subordinates?—I do not know that it would be of great advantage. There are expert tank-diggers among the people themselves who are extraordinarily good at laying out levels of channels and *bunds.* Any malguzar who wishes to build a big tank collects a body of these experts round the spot where he proposes to build his tank, has a talk with them over it, and decides what the levels ought to be and what the height of the *bunds* should be.

151. *Q.* You say in paragraph 20 on page 7 that tanks are often kept in a bad state of repair, particularly where the owner has himself little or no land below the tank and so on. I should infer from that that the existing law is hardly sufficient to enable you to compel an owner to put the tank in good repair. Don't you think that further powers are required? I don't think so. If the present powers are used freely, I think they would be quite sufficient. In any particular case where you may have to deal with a recalcitrant owner who refuses to repair the tank, the advantage you would gain by further legislation would be very small as compared with the danger of interfering with existing village customs.

152. *Q.* You think that the complaints often received by Revenue Officers are from rayats that the malguzars won't allow his tank to be cut. You send an officer to inspect the place and submit a report and a malguzar may be ordered to cut the tank and allow so much quantity of water. If he does not obey your order can you enforce the custom under the Wajib-ul-arz?

Mr. Craddock.—But he can bring a civil suit to set it aside.

Mr. Muir-Mackenzie.—Considering how valuable these tanks are as a measure of protection against famine in tracts exposed to it, do you think that if a general notification was made that the Government would never take any wet rates on account of improvements effected by the construction of tanks people would understand it and that it would give a considerable stimulus to their construction?—I thik it might.

153. *Q.* The thing was somewhat pressed elsewhere that if a man made a tank and took water from a stream the Government should not charge any royalty on that water and that fact should be made widely known. Would you not be prepared to go so far as that to encourage people to protect themselves?—I think it is an unnecessary sacrifice of revenue.

154. *Q.* Would the sacrifice be much? What percentage of revenue would that come to?—It might at present be estimated roughly at Re. 1 per acre.

155. *Q.* Suppose you had 500,000 acres, don't you think it is giving up 5 lakhs?—It is 5 lakhs a year.

156. *Q.* Yes?—I do not think it would be a sufficiently strong stimulus to justify the sacrifice of so much revenue.

157. *Q.* If that is proclaimed everywhere don't you think it would rather strike them as being really something good?—I do not think it would be such a strong stimulus as a personal distinction or as an abatement of a fraction of their assessment. In Bombay you exempt the improvement perpetually.

158. *Q.* We exempt them perpetually, but that is a different thing. Like other Provinces we are not altogether consistent. If a man takes water from a stream the theory is that the stream belongs to Government and the water taken therefrom must be charged for. It has been suggested by many people that we should not do that in areas exposed to famine in order to encourage people to utilise water as much as they could, and that we must tell them that we would not charge anything for the water so taken?—I am under the impression that although you except improvements you do take a wet-rate or an irrigability rate.

159. *Q.* We take subsoil water assessment in one part of a particular district. But that is stopped?—I was under the impression that you took subsoil water advantage rate all over the presidency.

Mr. Rajaratna Mudaliar.—In the Madras Presidency there is no charge. The land is classed as dry and even in the revision of settlement its classification is not altered.

Mr. Muir-Mackenzie.—In what way will you manage to estimate the areas that are irrigated by percolation. Is it not rather a difficult business?—I can give you statistics which will show you the area that is irrigated by percolation at the time of the settlement because it is then recorded what area is irrigated and what is irrigable.

160. *Q.* It is, as a matter of fact, land ascertained by inspection to be irrigated?—Yes, and it is the best irrigated land of the lot.

There was one statement by Mr. Harriott which I do not think was quite understood. When he was examined, I understood him to say that cultivators only paid water-rate to the owners of private tanks in years when they took water. That I think is not correct. As far as I have ascertained from cultivators they pay water-rate every year whether they take water or not, except in years when water is not available.

Mr. Rajaratna Mudaliar.—Government spent large sums of money in this Province in the last famine in repairing many private tanks?—Yes.

161. *Q.* Can you say what amount was spent and how many tanks were thus repaired?—I am afraid I cannot tell you. The Commissioner of Chhattisgarh has collected that information for you. He has got special statistics to show what areas are actually irrigated by works constructed by Government.

162. *Q.* Is there any intention of recovering the whole or a portion of that money from malguzars?—I believe not In the last famine the whole of the expenditure was incurred by Government. It was not advanced as a loan by Government, but spent by Government on relief works of which the malguzar was the manager.

163. *Q.* You stated in reply to Mr. Higham that legislation would be necessary to enable you to charge a water rate on lands commanded by new irrigation works whether water was taken or not?—Yes.

164. *Q.* Don't you think that the difficulty could be got over by classifying the land as wet in your settlement and assessing water advantage rate?—One objection from the Government's point of view is that the revenue would never be realised except upon a revision of settlement and therefore if the Government made irrigation works during the currency of a settlement it would get no return until that settlement has expired.

165. *Q.* Could not that difficulty be got over if at the original settlement you declare in the notification that the classification of the land would be altered during the currency of the settlement if the Government spent money on constructing irrigation works?—That might perhaps be possible. But I am not quite sure whether it will be legal under the present law. It will be a very cumbrous way of doing it.

166. *Q.* Is it not an easy way of getting over the difficulty about legislation?—It is open to the strongest objection in that half the increase goes to the landlord who has not spent anything.

Mr. Rajaratna Mudaliar.—In the Periyar tracts the Government reserved such a power and if the same course be followed in this Province we might avoid the necessity for legislation.

Mr. Higham.—They do not reserve it in this Province.

Mr. Muir-Mackenzie.—They might reserve it in the next settlement.

Mr. Rajaratna Mudaliar.—During the currency of the settlement?

Mr. Muir-Mackenzie.—You cannot issue a notification during the currency of a settlement. We follow the same practice in Bombay. At the time of settlement we notify that the assessment is not liable to enhancement during the period of settlement, except if the Government were to introduce improvements. You cannot do that under the existing law in this Province?—I do not think so, and in any case the malguzar would, under such a system, get half the increased rental, whereas Government ought to get the whole.

Mr. Rajaratna Mudaliar.—You object to the permanent exemption from enhancement of assessment on account of private improvements?—Yes.

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167. *Q*. Seeing that the Government does not spend any money on such improvements, on what ground do you object to such exemption?—My ground is that all improvements of that nature are based upon the advantages of the soil and therefore the Government is entitled to a share in the profits of those advantages. If a land is irrigable from a well, the owner is not entitled to the whole exemption simply because he has built a well. The Government is entitled to some share of the profits because it was found possible to build a well on that land.

168. *Q*. (*Mr. Muir-Mackenzie.*)—You mean that land with water within easy reach is more valuable than land with water at a greater depth?—Yes.

169. *Q*. (*Mr. Rajaratna Mudaliar.*)—But the Government would not reap any advantage unless the rayat built the well. He pays his own money and reaps advantages with the aid of irrigation which the Government has not provided?—The Government provides him with the land and provides him with water at a particular depth.

170. *Q*. Does the Government spend any money in providing water?—No.

171. *Q*. That is the reason for permanently exempting from enhancement all assessment on improvements. In 1851 this exemption was granted. Since then there has been an enormous increase in the number of wells in the Madras Presidency. The people understand and appreciate it because the land is classed as dry. There is a misapprehension in Bombay but not in Madras. You refer in paragraph 13 to the system of remission of one-eighth *jama*. How would it remove the misapprehension? On the total holding there would still be an enhancement?—The misapprehension would be removed like this. In the first place, you would remit one-eighth of his revenue straight away. You give him a reduction to start with. Supposing a malguzar has a village which pays a revenue of Rs. 100, you remit one-eight of that at once, and you say to him—"Your *jama* will not be enhanced for a period varying with the amount of money spent." If he spent Rs. 500 the period might be 10 years, and if he spent Rs. 1,000 it might be 20 years. He will have an exemption of one-eighth of the full assessment for all time.

172. *Q*. You would not give it to him on the whole village? No, only the area improved.

173. *Q* But the assessment of the village as a whole may be enhanced?—Yes. But the area improved is made into a separate *makal*, the revenue of which is not enhanced.

Mr. Muir-Mackenzie.—It is very much on a par with what is highly valued in Madras—something like an *inam*.

Mr. Rajaratna Mudaliar.—Under your system of assessing the entire village may not the malguzar be led to think that the enhancement on the village is so great as to swallow up the one-eighth remission?—My proposal would work as follows:—If a man has got a village and makes a tank, so much of the land as is irrigated by that tank is marked off. You give him a separate *patta* for that part, and give him a separate *sanad* saying that he holds at seven-eighths of the existing *jama* for many years and on the expiry of that period, permanently at seven-eighths of the *jama* assessable. He thereupon becomes a *tukumdar*.

Mr. Craddock.—If you explain to every man the rate on each of the different soils, he would not probably understand it. But if you just mark out a portion and calculate a separate assessment on it he will understand it.

Mr. Rajaratna Mudaliar.—He will get one-eighth remission.

The President.—That might be doubled or trebled in value in course of time.

Mr. Rajaratna Mudaliar.—At the next revision what will you do?—He will hold at seven-eighths of the *jama* existing at the time when the improvement was made for his fixed period of years, irrespective of the fact whether a revision intervenes in that fixed period or not. Suppose the area is assessed at Rs. 100 before the improvement is made. On making the improvement, the holder will be allowed to hold at Rs. 87-8-0 for his fixed period of years, say 25 years. During this fixed period, a revision settlement may be made in the district, say after 15 years, in which the *jama* assessable may be raised from Rs. 100 to 150. For the remaining 10 years of his fixed period, he would still hold at Rs 87-8-0 and at the end of that period he would hold at seven-eighths of Rs. 150.

174. *Q*. But the enhancement at a subsequent revision on this particular plot might be so high as to swallow up the remission?—The remission can never be swallowed up, because, but for the remission, the enhancement would be still higher.

175. *Q*. That is a doubtful point. The whole difficulty will disappear if, as Mr. Muir-Mackenzie stated, you grant permanent exemption for improvements.

Mr. Craddock.—At any rate you must insure to Government some portion of the increase.

Mr. Rajaratna Mudaliar.—The increase due to high prices will be secured to Government.

Mr. Craddock.—You should get something out of the water advantage as well.

Mr. Rajaratna Mudaliar.—Is it worth while claiming it, considering the advantages that you otherwise derive?

Mr. Craddock.—It may be several lakhs of rupees.

Mr. Rajaratna Mudaliar.—Considering the number of wells and tanks that you have, can you not afford to forego the amount?—You will have a great deal of opportunity of hearing what the native witnesses say, and I am inclined to think they will consider my scheme a greater stimulus to improvements than permanent exemption of the improvement.

176. *Q*. Mr. Chitnavis said that he advocated permanent exemption?—You ask ordinary men which they would have permanent exemption of improvements or *tukum* grants. You will find that the majority will plump for the *tukum* grant.

177. *Q*. There is something very tempting in the offer of making them *muafidars*. But when they find that at the end of the next settlement the enhancement has been very great, they will turn round and say "all this was a blind."

Mr. Craddock.—They do not look so far as that. They leave all to chance.

Mr. Rajaratna Mudaliar.—In page 7 of your Appendix the number of tanks shown against 1894-95 in Seoni is 2,411, whereas the number in the preceding and succeeding years is only 500 and odd?—I have verified the figure and it is correct. The difference is probably due to the fact that in 1894-95 every petty pond was returned as a tank.

178. *Q*. On page 11 the area irrigated uner wells in Balaghat Khalsa in 1892-93 is shown 13,085; but for the preceding and succeeding years the figures respectively are 3,211 and 2,228. The number of wells does not show a large variation?—I have verified the figure, which agrees with the returns, but I cannot explain the difference.

179. *Q*. In the same way in the Bhandara Khalsa, the area under wells in the year 1899-1900 was 1 977, whereas in the next year it rose to 2,300, although the number of temporary wells shows a decrease from 1,331 to 403? In the year 1899-1900 there was famine, when all the wells ran dry and the amount of the area irrigated was extremely small owing to the limited supply of water; but the year 1901 was fairly good and the wells commanded a good area.

180. *Q*. In the year proceeding 1899-1900 temporary wells were over 1,000, whereas it fell to 163 in 1900-01. Is there any mistake?—On verifying the figures I find that, through error, the number of wells was returned as 436 instead of 1,163. The latter figure is correct.

181. *Q*. On page 13 in regard to Bilaspur Khalsa against 1896-97 there is an enormous jump under "other sources," the area irrigated being 30,871 as against 1,576 in the preceding year?—I have verified the figure, which is correct according to the returns. In that year of short rainfall the cultivators resorted very freely to streams for obtaining irrigation water.

182. *Q*. On page 7 of your note in paragraph 19 you use the term "net cropped area". What does that term mean? Is it exclusive of the second crop?—The net cropped area is the actual area under crop, irrespective of the fact whether it was cropped once or twice.

183. *Q*. In giving exemption which you propose to do by *muafi* would you take a money limit or an acreage limit?—I would take both limits.

184. *Q*. Would it be possible to estimate the outlay? Would it not be safer to take the acreage limit, the

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probable area that might be irrigated, instead of the outlay?—Under our present system we take both the limits without any difficulty.

185. *Q.* How would it be possible to fix the outlay?—We do it by local inquiry at the time of the settlement.

186. *Q.* A proprietor may say that he spent Rs. 10,000 while he actually spent only Rs. 2,000?—The *bund* is there and the tank is there. Anybody can measure up the earth-work and see what the amount of the earth-work is.

187. *Q.* Is it not sufficient to take the capacity of a work and the area irrigated and then grant the exemptions?—I think not. In that case if a man has got an extremely favourable work in which his outlay per irrigated acre is very small indeed, he would not come under the exemption rule, although he may be well entitled to it. If you limit large works to the sum spent per acre, which is, I understand, what you suggest, it may be that a man has a favourable site in which he could make a tank at a cost of Rs. 500, and irrigate a large area; he would not come within the limit of exemption. But if he had a more difficult work which had cost him Rs. 1,000 you would then let him in.

188. *Q.* I did not mean that. I put it to you, if a man spent a sum of money and irrigated 20 acres in a more favourable place, and another man who spent twice the sum was only able to irrigate half that area in some other locality, the second man would be in a less favourable position than the last man?—What I propose to do is to draw a distinction between larger works and smaller works. I cannot draw that distinction on the cost per acre. If I do that, I may exclude a man who may have spent a large sum upon a work which irrigates a small area.

189. *Q.* How would you distinguish them?—You have the capital outlay of the tank, say, Rs. 1,000. Exemption will not extend over an area upon which less than, say, Rs. 10 per acre has been spent. If he spends Rs. 1,000 to irrigate 100 acres of land, he will get it all free under the exemption rules. But if he irrigates 150 acres of land, he will only get exemption for 100 acres.

190. *Q.* Suppose he irrigates 50 acres?—He will get exemption for those 50 acres only. That is, he will get exemption for the actual area benefited by the tank, provided it does not exceed the maximum limit.

191. *Q.* Your money limit must be very arbitrary?—It is an arbitrary limit. You cannot have anything but an arbitrary limit. I suggest Rs. 12 an acre.

192. *Q.* What is the objection to granting exemption to the whole area irrigated?—Because it may be unreasonable. By throwing a *bund* at a cost of Rs. 20 across the stream a man might be able to irrigate 100 acres. For making that small *bund* it is not necessary that the Government should give up its revenue on those 100 acres of land. It is unreasonable to expect Government to do it.

193. *Q.* Suppose you were given a large sum of money to distribute in the way of loans for the construction of wells, would you spend it on the construction of wells in wet lands rather than on dry lands? Suppose you had a lakh of rupees to advance for the construction of wells, would you prefer to advance the money to persons who wish to sink wells in wet lands under tanks, or to persons who wish to sink wells on dry land?—I would prefer to sink wells on dry lands.

194. *Q.* On what ground?—Because the wet land at the present time is at least partially protected.

195. *Q.* Where it is not fully protected, would it not be better to spend the money on the construction of wells in such areas so that they may be fully protected by enabling the cultivator to give one or more waterings and thus protect the crops which might otherwise be lost?—I think I would prefer to spend it on the worst protected dry crop lands.

Note on irrigation in the Central Provinces by R. H. Craddock, Esq., Officiating Commissioner, Nagpur Division.

Mr. R. H. Craddock.

(*Pachmarhi, 21st March 1902.*)

In the following note I have set down the conclusions which I have formed on the subject of irrigation in the Central Provinces, as the result both of previous experience of the province and of my tour with the Irrigation Commission.

Heads under which considered.

2. The subject-matter of the note is considered under four heads:—

I.—The agricultural circumstances of the province, showing the extent to which irrigation is already practised.

II.—The measures which should be taken by the State itself to extend irrigation.

III.—The means and extent to which private effort should be stimulated and assisted in providing or improving irrigtion.

IV.—The immediate practical steps to be taken to bring about the objects desired.

I.—The agricultural circumstances of the province, showing the extent to which irrigation is already practised.

Reference invited to reports on the famines.

3. An account of the agriculture of the province as it was in normal times, and of the effects upon it of the series of bad years which culminated in 1896-97, is given in the Report on the Famine of 1896-97, Chapter I (paragraphs 12 to 26), and this account was subsequently brought up to date in the first chapter of the Report on the Famine of 1899-1900 (paragraphs 15 to 31). A reference to these paragraphs will save an overburdening of this note with a number of details and figures.

Natural features affecting agricultural practice.

4. Soil, rainfall and subsoil are the main factors in determining the different agricultural practices in various parts of the province. In respect to the two first, we are in possession of fairly complete information; but as regards the last, which is also possibly the most important, our knowledge is extremely meagre and unapplied.

Differences in black soil.

For instance, subject to correction by anybody with scientific knowledge, I would account for a very marked agricultural difference between our deep black soils in different parts of the province by peculiarities of the subsoil or underlying rock. In the areas to the west of the province, comprising Nimar, the Sausar Tahsil of Chhindwara, the portions of Nagpur and Wardha which lie to the west of the Pench and Wunna rivers, respectively, and a strip of country along the Wardha river in Chanda, it will generally be found that the underlying rock is trap, that the stony uplands consist of trap rock as yet imperfectly distintegrated, that the poorest plateau and slopes will produce with good rainfall fair crops of *juar* and cotton, and that the light millets *kodon* and *kutki* are hardly at all grown; while in the valleys and deep soil fields those same crops, cotton and *juar*, flourish alike in dry and wet years, wheat being, as a rule, less successful, and sometimes only yielding a crop with irrigation.

Black soil in the trap areas. Cotton soil.

These are also the tracts in which the rainfall is lightest. Even in dry years losses on the uplands are generally made up by the crops grown in the lowlands. In 1896-97 these tracts escaped famine. In 1899-1900 they pulled through better than most places, except when the July rainfall totally failed and the young seedlings withered away. In 1868-69 also they escaped almost unscathed. They are the most prosperous tracts in normal times, and are making the best recovery from the recent failures.

Black soil which is too heavy for cotton.

5. There are also enormous areas of black soil to the east of the boundary line which I have roughly indicated. But it carries wheat without irrigation, and *juar*

and cotton fail upon it in wet years, and do not thrive upon it except in dry years. These crops are generally produced with success only in particularly well-drained land, generally on sloping fields near river banks. In these areas elevation of surface generally brings to the top light gravelly or sandy soil, which can only produce small millets and grasses or light autumn oilseeds. In all these districts, subject to particular exceptions, the underlying rock is granite, sandstone or laterite, and it is unusual to find black soil in hill situations.

Origin of black soil.

6. I believe that a good deal of geological controversy has centred round the origin of the black soil. Some assert that it owes its colour to decayed vegetable matters; others that it is merely disintegrated trap. It seems possible that both theories are correct, and that wherever it is made up largely of disintegrated traps, the soil will be found in upland situations, and generally less retentive of moisture in lowlands; while, where it consists merely of surface alluvium, it owes its colour to decayed organic matter, and is only to be found in level or lowlying places.

You will sometimes find a heavy wheat-growing black soil in a village which lies low in a trap area, but the deep soil village which will grow cotton but not wheat in level fields is a rarity in the non-trap areas.

Rice tracts.

7. Whenever the underlying rock of sandstone or laterite comes to the surface in level plains the land is best for rice cultivation, and the bulk of our Wainganga and Mahanadi rice tracts fall within this category. In Sambalpur, in fact, black soil is almost totally absent.

Influence of environment on cropping.

8. The agricultural practice in the matter of selection of cropping is, however, greatly influenced by environment. Where there is a large preponderance of light soil suited to rice, rice will also be grown on the adjacent black soil; where cotton and *juar* are the prevailing crops, they will be grown on fields which might better produce wheat; where the heavy soil suited to wheat is most prevalent, wheat will also be grown on the light soils which should be cropped with cotton and *juar*. Want of communication has intensified the effects of immediate environment in the past; and we see these effects in the present day in the manner in which black soil is devoted to rice in Chhattisgarh, or rice neglected for hill millets in Mandla and the plateau district. Custom (*rawaj*) has influenced the character of the cultivation. This effect of environment is a fact which it is important to keep steadily in view in any irrigation programme; for, although irrigation may be most rapidly and usefully extended in tracts in which it is already practised, its absence is far from being conclusive proof either that it is impossible or useless.

Has some importance in the matter of irrigation

In the main the cropping of a tract is that which is best suited to its soil and climate.

9. While, however, we may strive to improve agriculture by improving land which is not used to its full capacity owing to the prejudice of its environment, it would be folly to suppose that the main system of cropping of each tract is in itself unsuitable. We may certainly accept the facts that the trap country with its light rainfall and well-drained black soil is best devoted to cotton and *juar*; that the heavy soils of the Nerbudda valley are best suited to wheat, and that the light yellow and red soils of the Wainganga and Chhattisgarh must always look to rice as their principal product. We may remove the prejudices, but we cannot change the environment.

Application to the above of principles to be followed in introducing irrigation.

10. The same principles must be followed in devising irrigation schemes if success is to be attained. In the wheat country we must provide a system of irrigation which is suitable for wheat; in the rice country for rice. Only if we find in the wheat or rice country a tract or kind of land which would in the rice or wheat country, as the case may be, be devoted to rice or wheat respectively, is it desirable to encourage, and provide irrigation for, an alteration of the cropping.

Reasons why irrigation has been limited in the past.

11. As will appear from the extracts from the Famine Reports to which I have drawn attention, until the famine of 1896-97 the people of the province had suffered as much from excessive as from deficient rainfall. Premature withdrawal of the rains or dry cold weathers had of course been experienced, but the losses suffered had always been local and partial, and attention had been given to irrigation only when irrigation was an incident to the raising of the particular crop which the locality favoured; that is to say, in the case of the heavier varieties of rice, sugarcane, and garden produce. When the practice was, as in the Wainganga districts, to grow transplanted rice, irrigation was more developed and understood; where, as in Chattisgarh, broadcast cultivation of rice was the common method, it was much neglected, or confined to particular classes of cultivators or particular villages. The cultivation of cane and garden crops was a luxury to be enjoyed only by the well-to-do, or by special communities of garden cultivators of the caste variously known as Malis, Kachis or Mtrars, who had generally settled of choice in places where water was near the surface and wells easily sunk.

With the single exception of rice cultivation, it never entered into anybody's head that the irrigation of a field crop might be desirable, and the irrigation of wheat was confined to small patches subsidiary to a garden crop. It must be admitted that there has not been sufficient time for the people to change their practice.

Existing statistics of irrigation.

12. The statistics we have are subject to errors and defects, but they are sufficiently accurate for all broad issues. I select the figures of 1895-96. It was a year in which the rains withdrew early, and it was the first dry year to succeed a number of wet ones. The state of irrigation in the province before the rude awakening took place may be judged from the figures of that year. The first table which I give shows the distribution of the irrigated rice area :—

TRACTS.	AREA UNDER RICE IN 1895-96.		
	Irrigated.	Unirrigated.	TOTAL.
	Acres.	Acres.	Acres.
Northern districts, excluding Seoni.	358	520,438	520,796
Wainganga rice districts in Nagpur Division *plus* Seoni.	511,476	654,388	1,165,864
Chhattisgarh . .	153,487	3,140,095	3,293,582

Tank irrigation of rice.

The difference in practice has been very remarkable. The northern districts attempt practically no irrigation; the Wainganga districts irrigate all they can; in Chhattisgarh irrigation is in its infancy; and Sambalpur contributes half the amount shown against the Division. It may be reckoned that a full rice area for the province would be 5 million acres, of which little more than a tenth receives irrigation in ordinary years. In dry years this proportion is lowered by failure of tanks, and in years of complete drought the area protected is infinitesimal in proportion to the whole. Thus the irrigated rice area of the Wainganga districts fell to 451,000 acres in 1896-97 and to 75,000 acres in 1899-1900.

Effect of failure of rains on double cropping.

A failure of the rains in these rice districts entails further consequences in reducing the area double-cropped. In the wet year 1894-95 the double-cropped area was 1,716,000 acres. In 1895-96, a dry year, it fell to 1,206,000 acres. In 1896-97 it was only 565,000 acres, and in 1899-1900 it actually fell to 164,000 acres.

Advantage of irrigating rice illustrated by Raipur.

13. The enormous advantage to be gained by irrigating the rice lands of the province needs no elaborate argument or proof; a few figures will illustrate it. If we take 1¼ million acres of rice in Raipur as the area now unprotected by irrigation, having an average yield of 900 lbs. per acre, then the whole area would yield in an average year 300,000 tons of cleaned rice.

In 1895-96 the late rains were scanty, and the crop was only 60 per cent. of normal, or 180,000 tons. In 1896-97 the yield was only a quarter, or 75,000 tons. In 1897-98 the crop was full average; the same in 1898-99. In 1899-1900 the yield fell to about 30,000 tons. If then it be assumed that the average yield were only raised by 33 per cent. (an assumption which is pitched designedly on the safe side) by complete irrigation, the normal produce should be 400,000 tons of cleaned rice.

The account would then stand :—

YEAR.	Amount harvested.	Amount that would have been harvested with complete irrigation.
	Tons.	Tons.
1895-96	180,000	400,000
1896-97	75,000	400,000
1897-98	300,000	400,000
1898-99	200,000	400,000
1899-1900 . . .	130,000	400,000
TOTAL .	885,000	2,000,000

The difference in yield during the five years would then have been at least a million tons, or an amount equal to four years' food-supply to the population of the district. But this is not all; for the calculation does not allow for the loss of cropped area after the famine due to want of seed, loss of population, and general impoverishment; nor has account been taken of the value of the second crop. The area double-cropped in the Raipur district in the wet year 1894-95 was in the Khalsa (for the zamindaris were not then completely surveyed) 579,000 acres. Assuming that, with steady irrigation of the rice, an area of 600,000 acres, with a yield of only 200 lbs. an acre, might be annually double-cropped, the normal production of food-grain resulting from the double-cropping would be 120,000,000 lbs., or in round numbers 53,000 tons. But in the series of years following 1894-95 the area double-cropped fell as follows :—

	Acres.
1895-96	317,000
1896-97	205,000
1897-98	355,000
1898-99	378,000
1899-1900	14,000

Even if the area double-cropped in each of these years had yielded the full 200 lbs. to the acre, there would have been a large deficiency below the standard of 50,000 tons; but it was short in most of these years, and in the last it was practically *nil*.

If the gross losses for want of irrigation during this period be taken as a million and a quarter tons, the money value of this at the moderate rate of 20 seers to the rupee is represented by no less than 7 crores of rupees. In the two famines Government spent a crore and a half in this district alone on famine relief. Its advances to cultivators have amounted to 15½ lakhs, and its loss in land revenue remitted and in settlement operations postponed would not fall far short of 20 lakhs. It would be no exaggeration to say that, taking all heads of revenue, the loss to Government has been two crores on account of the Raipur district.

Extent of protection necessary to avert actual famine.

14. To irrigate all the rice land of Raipur is of course an impossible task; but some considerable stride in that direction is necessary if we are to save the district from famine. With a population of a million and a half, we require for a year's food-supply at least 250,000 tons of food grain; but there are always some stocks, and with the help given by other crops, we might reduce the amount required to prevent actual famine to half that amount, or 125,000 tons, or even 100,000 tons. At this rate the irrigation of 500,000 acres would suffice as a certainty, and of 400,000 at a pinch. This would cost two crores at Rs. 50 an acre, but by free resort to *tars* the cost might be much reduced.

The scantiness of rainfall has not been at fault so much as its distribution and the ineffective means of storage. Even in 1899-1900 Raipur had 11 inches of rain in August as against a normal of 13¼, and Bilaspur 20·74 as against a normal of 11, and well-constructed tanks would have held some water for the much-needed September supply, had such tanks been in existence.

Irrigation of rice to be first pushed.

15. The irrigation of rice is at once the most promising and necessary objective at which to aim, but there are differences in the attitude of the people towards it. We have, besides providing it, to teach irrigation in the northern districts, preach it in Chhattisgarh; while in the Wainganga districts the provision alone will suffice—the people will readily take water directly it is made available.

Irrigation from wells.

16. Irrigation from wells plays a very subsidiary part in the agriculture of the province. There is some well irrigation of wheat in Nimar, mainly on soil which does not yield wheat well without it; and the same may be found on a smaller scale in the trap cotton-*juar* conutry, especially in the Arvi and Katol Tahsils of Wardha and Nagpur. Wheat will also be irrigated on a small scale where garden cultivation has been abandoned. But outside the cotton-*juar* country there is practically no settled irrigation properly so called, and sugarcane and garden crops grown by special classes of cultivators are the most important instances of well-irrigation.

The cultivation of garden crops requires generally some capital and much industry, and the average field cultivator, unless he has some hereditary instincts in that direction, will rarely bethink himself of starting a vegetable garden.

Possible field for extension of garden produce how far limited.

17. So far as these gardens grow only perishable market produce for local consumption, the idea of extending them very largely is perfectly futile; but the case is otherwise with spices, fruits or other produce which is capable of export. For instance, earthnuts (*mungphali*) might be cultivated more extensively. Some years ago a notable feature in the trade returns was the fact that the province had large net exports of chillies. But this was a solitary instance, and in the majority of years there is a large net import of this commodity. In 1900 the value of imported chillies amounted to Rs. 5,39,000, while the exports are only Rs. 28,000. There is thus scope for an increase in cultivation of chillies. The same is true in respect of ginger and turmeric. As regards sugarcane, the reasons alleged for a decline are so many and contradictory that one can speak with less confidence. But there is a very appreciable scope for the expansion of garden cultivation along present lines. The crushing assessment on garden industry imposed by the Maratha Government has been considerably lightened by our Settlement Officers at the recent settlements, and the old opium rents have been very generally reduced.

Actual statistics of garden crops.

18. The last normal year for which returns are available shows the following details of well-irrigation :—

Number of wells—	
Temporary	46,564
Durable	12,633
Total .	59,197
Area irrigated from wells	**77,252**

	Acres.
Compare irrigated areas shown as under—	
Sugarcane	23,425
Grass and orchards	3,765
Garden corps of *kharif* season . . .	6,260
Miscellaneous food-corps of *kharif* season .	1,533
Miscellaneous non-food crops of *kharif* season	299
Tobacco	36
Garden crops of the *rabi* season . . .	4,601
Miscellaneous food-crops of the *rabi* season	1,282
Miscellaneous non-food crops of the *rabi* season	22
Total .	41,212

Extension of irrigation to field crops.

Some of the sugarcane is irrigated from tanks, so that if the total well-irrigation is correctly stated, there must be nearly 40,000 acres of field crops receiving water from wells. The latest returns have shown as many as 30,000 acres of irrigated wheat over the province at large. There is therefore distinct hope of extension of well-irrigation even to field crops, though it would be too much to hope for any efficient protection against famine by this means alone. Even if well-irrigation were to be trebled, the effect on the harvest earnings of labourers would be small.

Out of the total area of 77,000 acres irrigated from wells, the following districts are those in which the areas are largest, in which therefore the best hope of extension lies :—

	Acres.
Saugor . .	5,061
Nimar . .	13,041
Betul . .	9,002
Chhindwara .	6,001
Nagpur . .	10,127
Raipur . .	8,583
Sambalpur .	3,645
Total .	56,260 or 73 per cent. of the whole.

The area of well-irrigation is particularly trifling in the districts of Mandla, Seoni, and Bilaspur, and in Raipur it is small relatively to the total cropped area.

Other sources of irrigation.

19. Under the head "Area irrigated from other sources," the returns of 1898-99 show nearly 27,000 acres. This class of irrigation, which in the main relates to water lifted from streams, is of little importance except in Chanda, where 4,000 acres are thus irrigated. It also includes irrigation by channel from bunded streams—a form of irrigation which is fairly common in Raipur, being known as the *tar* system, and has latterly been extended in Jubbulpore. The area so irrigated in Raipur in 1898-99 was 7,500 acres, and it appears to be the cheapest form of extending irrigation, in that district at all events.

Extent to which the country is already protected by irrigation is very small.

20. The total irrigated area from all sources in 1898-99 aggregated only 654,000 acres out of a cropped area of nearly 16 million acres, or just about 4 per cent. In the following year it dropped to 1½ per cent., thereby showing the liability of the supply to fail when most needed. Whereas, however, irrigation from tanks and *tars* fell by over 60 per cent., the decline in well-irrigation was only 17 per cent.; and whereas the wells in use remained fairly constant, one quarter of the tanks could not be used at all, and few of the rest gave any sufficient supply. For the limited area they will protect the well is therefore greatly more dependable than the tank, but the cost of extensive protection by wells in this province is prohibitive when regard is paid to the limited resources of the cultivator.

The bunding of fields for wheat cultivation.

21. There remains one kind of *quasi*-irrigation to be considered, and that is the bunding of fields for wheat with incidental rice cultivation in level places where the *bunds* are not obliged to be too high.

Present area of embanked land

We have no annual record showing the extent and progress of bunded fields, and it would be most instructive if such a record were available; but in districts re-settled, in which bunding for wheat is a regular practice, the soil classification effected at the settlement will show the state of bunding at the time. The following table refers to a few districts :—

	Area embanked.	Area under wheat and wheat-gram at Settlement.
	Acres.	Acres.
Damoh . .	39,411	251,000
Jubbulpore . .	347,704 (fully) 56,554 (partly)	461,000
Seoni . . .	10,497	276,000
Narsinghpur .	52,220	238,000
Balaghat . .	18,602	17,000
Nagpur . .	9,194	320,000

There is also a considerable bunded area in the Powni pargana of Bhandara, which extends into the adjoining district of Chanda.

Effects of drought on the practice of bunding.

22. The practice of bunding fields for wheat cultivation has received a great impetus from the cycle of dry years, and it continues to spread every year. The spread of *kans* grass in Saugor, Domah, and Hoshangabad has been very great and bunding is now regarded as the best means of eradicating it. This I believe to be a mistake. If the money spent on *bunds* were spent on powerful cattle and deep ploughs, and the roots of the *kans* exposed to the hot-weather sun, the weed could be killed; but as the bunding has many other advantages and the eradication of *kans* is one of them, the idea is not one to be discouraged.

Scope for extension of bunding.

As will be seen, there is a certain amount of bunding in most districts, almost invariably to be found in those areas where real black soil is found adjacent to rice cultivation. From there it has spread to the regular *rabi* areas. There exists scope for the extension of bunding in Saugor, Damoh, Narsinghpur, Hoshangabad, Nagpur, parts of Wardha, and, I should suppose, in Raipur and Bilaspur. There is no chance of the practice being usefully extended in any area where it pays to grow cotton and *juar* even in wet years in roation with wheat.

Profits from bunding seem to far outweigh losses in wet years.

23. I must confess that when I started on my tour with the Commission I was somewhat sceptical as to the advantages of bunding. It seemed to be likely that in the experiences of the recent dry years the losses of the rust years had been forgotten. But after hearing the evidence of the witnesses of the northern districts, I have strong reason for thinking that over a long series of years the gains from the system of bunding are greater than the loss. Rai Bahadur Behari Lal, Kazanchi, who has spent Rs. 50,000 on bunds, gave strong testimony to this effect, and his opinion has been backed by his actions, since a good deal of the work was done before the years of rust and a good deal immediately after. Although rust does more damage in bunded than in unembanked fields, yet when there is an attack of rust, such as ruined the wheat crop of Saugor in 1894, there is nothing to choose between them. In years when rust is not so virulent, the extra losses in embanked land are small beside the extra profits made in other years. The actual cultivation expenses are reduced, weeds are kept in check. The tracts which came through the famine best, and which have deteriorated least, are the Jubbulpore *haveli*, the corresponding areas in Narsinghpur and Mandla, and the Powni-Chauras of Bhandara.

Rough analysis of crop areas and ultimate protection to be aimed at.

24. For the province as a whole—to wind up this part of the note—the standard cropping may then be taken as follows :—

	Standard area in acres.	Remarks.
1. Rice . .	5,000,000 .	Partially protected by tanks, 500,000 acres.
2. Wheat .	3,500,000 .	Partially protected by *bunds* about 500,000 acres; by wells about 25,000.
3. Cotton and its mixtures.	1,000,000 .	Rarely requires irrigation.
4. *Juar* and its mixtures.	1,500,000 .	Do. do.
5. Gram .	1,000,000	Partly protected by *bunds* and when grown in rice districts as a second crop by existing tanks, but, the areas so protected are small.
6. *Kodon* and *kutki*.	1,500,000 .	The only crops possible on some of the slopes of the Satpura districts; but capable of being replaced on level light soils by rice with irrigation, and on the black soils of Chhattisgarh by *rabi* crops or by *juar*.
7. Oil-seeds .	1,500,000 .	Not generally requiring irrigation. In the famine year 1899-1900 *til* gave a very large yield; but linseed failed from drought, and when grown as a second crop after rice, benefits from the irrigation of the rice.
8. Pulses of the *kharif* season.	500,000 .	For the most part benefit by the irrigation of rice which they follow.
9. Pulses of the *rabi* season.	1,000,000 .	See gram above.
10. All other kinds of crops.	1,000,000 .	Includes about 150,000 acres of sugarcane, garden crops, and groves, of which two-thirds are dry.
Grand Total ..	17,500,000 .	Of this 1,500,000 may be taken as second crops grown on rice land.

The net area cropped, that is to say, the area to which water has to be brought, is thus 16 million acres; but we may deduct from this the areas shown against heads (3), (1) and (7), at least two-thirds of item (6), and at least half of items (5), (8), (9) and (10), the omitted portions representing land which is or should be protected by *bunds*, or is already irrigated or cannot be irrigated. The balance remaining for irrigation will, therefore, be 10¼ million acres. The odd 1¼ millions will disappear in double-cropping to which irrigation of the rice crop will give protection, leaving 9 millions mostly consisting of rice and wheat land.

We have now half a million acres of rice partly protected by tanks, and half a million acres of wheat partly protected by *bunds*. We can improve the first, and aim at extending the second. If it be supposed that we double the area of the second and succeed in making the area of the first secure, we have to deduct another million and a half from the area to which water has to be brought. We still have 7½ millions to deal with, *i.e.*, 4½ millions rice, 2½ millions wheat, and half a million other crops.

The protection of a third of the rice area, and a fifth of the other areas, added to the areas protected or to be protected by existing tanks and *bunds* is, I should think, the utmost to which we can hope to attain, and should indeed suffice to save us from famine, provided that the protection is well distributed.

This would give us—

(a) Rice protected by irrigation .	2	million	acres.
(b) Wheat and *rabi* protected by irrigation . . .	0·5	„	„
(c) Wheat, &c., protected by *bunds*	1·0	„	„
(d) Other crops protected by wells, *tars*, or tanks . . .	0·5	„	„
(e) Double crops protected by irrigation of rice . . .	1·5	„	„
Total .	5·5	„	„

The protection of one-third of the cropped area, added to the area which never fails entirely even in the year of greatest drought, *e.g.*, areas shown with cotton, *til*, *juar*, etc., should bring us through the greatest drought securely.

It is not impossible that this aim might be realized at an expenditure of 12 crores of rupees. The famine of 1896-97 cost the Government about 2 crores; the famine of 1899-1900 about 5½ crorers, or 7½ crores in all, including loss of land revenue and forest income, but not including all the consequent loss in subsequent years, due to deterioration of agriculture, loss of population, loss of railway revenue, and all the decline in public revenues which an impoverished condition of the people necessarily involves. This brings me to the second head of this note as to what the State should do.

II.—What the State should do of itself.

Circumstances in which the State should undertake works itself.

25. There are two circumstances in which the State must carry out irrigation projects itself—

Firstly, when the work is beyond the capacity and means of private enterprise;

Secondly, when the advantage of the work is not understood by the private individual.

Difficulties in the way of private enterprise.

There are a few large tanks in the Wainganga districts which were found absolutely protective in the famine; but these were constructed long ago, at a time when the constructors had a free hand and were not hampered either by the rights of their neighbours or of their tenants. It is difficult to lay down when a work is of sufficient importance to be constructed by the State. I do not think that the question can be decided by the number of villages which a particular work would irrigate. If one man owns two or three contiguous villages, or if the owners of two or three contiguous villages can be got to combine, and the work is not beyond their joint capacity, there is no reason why they should not jointly construct such a work. But if no such combination is possible, and the work is a desirable one, the intervention of the State will be clearly justified. It may be found possible to assist private enterprise by permitting land to be acquired for a private tank or *tar*, if a village community is thereby benefited; but frequent resort to such provisions would be likely to cause much irritation. Even in the case of a State work people whose lands are submerged by a tank from which only their neighbours or perhaps enemies will benefit will be greatly irritated by the acquisition, but such a feeling would be much intensified if the action was taken on their neighbour's private account and to his sole profit.

Main points to be settled in regard to the scheme of large works.

26. There is an immense field for irrigation in the rice districts, and a large number of projects have already been drawn up, the great majority of which are clearly beyond the resources of any individual.

So far as the large projects in these districts are concerned, there is no question as to their utility, and their construction depends upon the allotment of funds. But there are two questions to be settled which are of great importance. The one is as to the terms on which water should be given to the people; the other as to the degree and extent of protection to be aimed at.

Terms of payment for water.

27. First as to the terms. The people of the Wainganga will be ready to pay for water at once, they fully appreciate the advantages of irrigation. The people of Chhattisgarh have still to be educated up to the advantages of it. I have no doubt that the education will come very easily, but it will be stimulated by giving them water free for a year or two, or, perhaps three years. In the same way in the Wainganga tracts it would be as well to offer water at a low rate at first, with full intimation that it will be raised later on. Compounding for an annual payment must follow; no reasonable composition is likely to be offered until the people see how far the water goes, how many waterings they are likely to be able to get, and generally how it has affected their incomes. Anything in the way of free water, or water at a nominal rate, must be offered for a very short time at the outset. The people must be taught to value the water by paying for it, and they must not have time to get used to an enhanced income. Special attention must be devoted to ascertaining details in the first instance; it cannot be left to patwaris or subordinate officials.

Concessions should be for a short time only.

Standard of protection. Prudential considerations should not be carried too far.

28. The next point is, what is to be the standard of irrigated area to be aimed. It is of course clear that it would be foolish to spend all the water on a single watering of 2,000 acres instead of keeping enough water to protect 1,000. But the prudential consideration can be carried too far. If, for instance, a tank can irrigate 5,000 acres in an average year, but would only water 1,000 acres in a year like 1899-1900, it would, I think, be foolish to irrigate only 1,000 acres annually on the chance of that one dry year occurring. It would be far better to irrigate, say, 2,500 acres, every year, and only 500 in the case of extreme drought. This would enrich 2,500 people for, say, 29 years out of 30, and 1,000 of these would save half their crops in the famine year. Whereas, on the other method, there would be 1,500 people not a pin better able to resist famine than before, and water capable of irrigating their land would for 29 years have gone to waste. Moreover, the calculations would be entirely upset if a year like 1896-97 occurred; it would be madness in such a season when crops were withering all round, and distress or famine was imminent to retain water on the chance of a future year like 1899. It is better to avert one famine actually on the land than to lay by stores for two famines in the clouds; we must chance something. The difference lies between trying to guarantee a small number of people against total loss, instead of a larger number against actual famine.

Effect on credit of extending waterings in all ordinary years.

29. The enormous effect of credit in averting famine must not be overlooked. If, to go back to my example, the extra 1,500 people, who will be excluded altogether under one scheme, have under the other enjoyed profits for 29 years, they will either have saved enough to carry them over the 30th, when they get no water, or their creditors will know that in the 31st they will get water as usual and give them advances to carry them through. All that is necessary is to preserve a sufficient area to yield a seed supply for the whole of the rice lands which fall, so to speak, within the sphere of influence of your protective tank.

We must aim at years like 1896-97 rather than at years like 1899-1900: first, because it is a kind of failure which, in all human probability, is likely to occur most often; and, secondly, because, when it does occur, all considerations of reserving water for some possible future and greater failure must be thrown to the winds.

If a year like 1899-1900 followed a year like 1896-97, no doubt the area protected would be small; but it would still be much larger than if the tank had not been made, and it would fall on a people whose credit and resources were undiminished by previous loss. It will of course be objected that the irrigation of an area subject to large annual fluctuations will involve establishments to ascertain it and collect water-rates, while by irrigating a fixed and smaller area an annual sum, to be collected through malguzars, can be determined. There ought, however, to be no insuperable difficulty in dealing in the same manner with a larger area in all ordinary years and remitting fees chargeable on lands not watered in years of extreme drought. There must also, I think, under any system be always some surplus receipts from people who take water for sugarcane or *rabi* crops. That there will be difficulties is undeniable, but the best solution will lie in making a tank and seeing how it works.

Irrigation should be diffused over the most precarious areas and not concentrated in one.

30. Whichever criterion be accepted as to the degree of protection to be aimed at in each work, the object aimed at must be to protect a certain area in each definite tract of the district which is liable to failure. It is better to aim at diffusion of a measure of protection to a number of tracts than to make one corner of a district absolutely secure and leave others totally unprotected.

Advantages of the *tar* system of irrigation as compared with tanks

31. *Q.* While we are preparing and considering the possibilities of large reservoirs, we must not neglect to examine what is known in Raipur as the *tar* system of irrigation. Mr. Blenkinsop has shown that in the *Khalsa* areas of Raipur an expenditure on village tanks of Rs. 2,35,000 in the famine has added about 23,000 acres to the irrigable area. Labour was, of course, often insufficiently supervised, and sites badly selected on account of haste and want of experience; but if every allowance be made for this, the advantage in favour of *tars* is remarkable. Of these he writes: "The few *tars* constructed, where they did not burst, irrigated areas out of all proportion to the expenditure incurred, *e. g.*, the Patharia *tar*, costing Rs 2,601, irrigated 4[illegible]0 acres, and the Tandwa *tar*, which cost Rs. 5,831, including also the cost of repairs to the Tandwa tank, irrigated over 500 acres. The Tora *tar* cost Rs. 1,770 and irrigated 420 acres."

If these results are even approximately accurate, the advisability of a number of cheap *tar* schemes would be indicated, not only in Chhattisgarh, but in other districts, where the system is at present little known.

Experimental irrigation.

State must take some risk.

32. The second case which was referred to in paragraph 25 above as a case in which the State was bound to do work itself is the case of improvements, of which the value is not known by the people. There are possible projects for tanks in the northern districts, which, if constructed, would either irrigate existing rice, or enable rice to be cultivated. There are also possible tanks to irrigate wheat on the lighter varieties of wheat land. But no individual will be willing to lay out capital on a work of the utility, of which he is not himself satisfied, and in many cases the State would have to take the risk of the experiment proving a partial failure, or a very expensive success. If, however, a real effort is to be made to protect the country, some risks of this kind must be run; but in order to save the chance of heavy loss, the expriments should be on a small scale.

The Lachera tank in Nimar.

33. There is in Nimar the Lachora tank, of which so much was heard in the evidence before the Commission. The tract in which it is situated is known as the Kanharpur-Boria tract, which resembles more the Nerbudda valley wheat country than the lands of Nimar. This tank should at once be removed from the control of the District Council, be repaired and improved, and the effect be tried of lowering the rates at present charged. It is believed that, if improved as proposed, it would irrigate 500 acres, and this is about the scale of tank which should be a maximum until the experiment of irrigating wheat land can be shown to be successful.

The Ramtek project.

A good deal was said in Nagpur about the Ramtek project. This is a very ambitious reservoir, which is estimated to cost ten lakhs of rupees and to be capable of irrigating 36,000 acres. The two arguments against the scheme are that it is a costly work to select as an experiment, and that on the whole it will irrigate a country which was not severely distressed in the famine. On the other hand, there is a good deal to be said in its favour. Firstly, the area to be irrigated contains a substantial amount of rice land, as well as a considerable area of garden cultivation; secondly, much of the soil is light and a good deal of land might better be used for rice than wheat; thirdly, while possessing these advantages the work would show how far wheat would be irrigated on black soil. Lastly, some villages within the area did suffer a good deal in the famine.

The country which the project would serve has therefore most of the characteristics which would influence choice for the purpose of an experimental project, and the only doubt is the expense. The same money might perhaps produce greater results elsewhere.

Introduction of irrigated rice into parts of the Nerbudda and the Satpura districts.

34. Again, as already stated, much can be done in some districts to educate the people up to rice irrigation, both in the Nerbudda valley districts and in the plateau districts. In Seoni the influx in the south-east corner of Powars from Balaghat resulted in some very excellent rice cultivation, but this area is cut off from Chhindwara by a wheat-growing *haveli*, and the light soil on the other side of this land has never been used for rice. There were 50 tanks constructed, repaired or improved in Chhindwara in the famine; but as Mr. Phillips told us in his evidence, only three of these have been used for irrigation, and few of them were found to hold water.

It is inconceivable that tanks cannot be made which will hold water in Betul and Chhindwara, and it is certain that many good sites could be found. But the people must be taught how to cultivate rice by importing rice cultivators to teach them, just as the Agricultural Department is now teaching some of the Bilaspur cultivators how to grow *juar*.

Cases in which Government can aid in construction of ***bunds*** and wells.

35. So far as tanks and *tars* are concerned, there is thus scope for much useful experimental work of a not very costly kind, which will show the way to private enterprise. There is less to be done by the State in the way of bunding fields and sinking wells. This work must be left almost entirely to private effort. But even in the cases of these works there are places in which the initiative may properly rest with the State.

In parts of the province where the *bunding* system is unknown, or the people bankrupt, a few of these works might be made by Government. If they were successful, private enterprise, assisted, if necessary, by *takavi*, would no doubt go on with the work. Similarly a great deal of land in the south of Nagpur is being spoilt by erosion and some specimen reclamation worked of this land would be most useful.

Lastly, in respect to wells, in Chhattisgarh they have had to be constructed by public funds in order to induce the people to drink well water, and it would be equally desirable to encourage wells for irrigation. Wells sunk under the *bunds* of tanks in what are known as the '*pajra*' areas have been found most serviceable in some parts of Madras and Hyderabad, and the Sambalpur witness spoke of them in Sambalpur. Any idea of saving the Chhattisgarh rice crop by means of wells in the case of drought, or any hope that the Chhattisgarhi will take to sinking wells by the hundreds when he sees his rice crops withering, must alike be regarded as illusory.

Wells in Chhattisgarh.

36. But in these matters the proverb that "every little helps" should never be derided. If there are wells to hand already constructed, even the Chhattisgarhi can be got to use them in time of need, and though they may not produce much food, they will at least help to maintain a seed supply. We learnt from a Raipur witness that special shifts were made during the famine to preserve some seed supply, and a small sum at least might be devoted to introducing the Hyderabad practice.

Agricultural associations should help to spread irrigation.

We are endeavouring now to introduce an agricultural association of leading agriculturist malguzars in every district, the members of which will, it is hoped, undertake in their villages, and report upon the most promising experiments which the Agricultural Department or their own members may bring to their notice. Efforts will be made to induce them to extend various methods of irrigation, and a little State aid in this direction will prove most serviceable.

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III.—The means and extent to which private enterprise should be stimulated and assisted in providing or improving irrigation.

Interference of Government in private works started in the last famine.

37. The conditions which I have ventured to indicate as determining whether the State should undertake works entirely from its own resources also afford the criterion as to what should be left to private enterprise. The traditional refusal to interfere with private property went by the board in the second famine: firstly, because it was felt that it was most undesirable to again press famine loans upon an impoverished people; and, secondly, because the programme of useful work on roads could not meet the demands for employment. The decision to improve, repair, and construct malguzari tanks was popular with the people and has resulted in much useful work. The amount of work carried out in this way is described in paragraphs 204 to 206 of the Report on the famine of 1899-1900, and the amount spent was as much as 67 lakhs. Greater results would have been achieved had a carefully-devised programme of such works existed when the need for them arose, and such a programme is now under preparation. The question naturally arises whether such work as the enlargement or improvement of village tanks should be left to the chances of another famine, and whether the better course would not be to minimize the chances of famine by increasing the protective value of these tanks.

Existing tanks.

38. According to the returns of 1898-99 there were 41,977 irrigation tanks being used in the province, out of which over 25,000 are to be found in the Wainganga country, including Seoni; 7,500 in Sambalpur; and 8,000 are tanks in Raipur and Bilaspur. The owners of these tanks are theoretically bound to keep them in a state of repair, but they are not, even theoretically, under any obligation to improve them.

Difficulties in the way of repairing and improving village tanks.

Where the proprietors are of cultivating castes on good terms with their tenants, there is a good deal of co-operation in the matter of ordinary repairs, and the proprietors will, if they have the means, occasionally incur a considerable outlay in major repairs or improvements; but with absentee landlords owning a number of villages, energy and money are seldom devoted to this object. It is true that there exists a power to notify an infringement of the Wajib-ul-arz with respect to the tank clause, but I can only recollect one or two cases in which the enforcement of that clause has ever been notified, and I am unable to say what the results were. It may be that if more pains were taken to enforce the clause before neglect had gone very far, some good may ensue. But if you fine a man Rs. 200 for failing to spend Rs. 500, you are not much nearer your aim. The man's capacity has been diminished by that amount and the desired work has not been done. That provision of the law is effective against an offence of commission such as the levy of fees for grazing which ought to be free, but it is hardly effective against a passive omission, especially when the omission is, as it may be, beyond the pecuniary resources of the person concerned to repair. One thing is certain that any fine levied for refusal to repair a tank should be at once applied to the repair of that tank, and this point should be noted for any special legislation which it may be found necessary to recommend for the furthering of irrigation.

Insufficiency of the present law to secure improvement.

39. But this will go a very small way to help us, as we shall be able to deal only with a few isolated cases of landlords who are able, but neglect, to repair their tanks. It will not help us in the case of those who are really unable to spend money, or in the case of tanks in which it is *improvement*, not merely repair, that is needed.

Advisability of contribution to this purpose.

It has been given in evidence that a great deal could be done to improve village tanks. Their sluice arrangements are primitive, or altogether wanting; their catchment areas are too large or too small. At a moderate cost their protective value might be improved. The owner is perhaps not equal to the task or cannot afford it. The Government derives at least half the extra rental value which irrigation may add to the assets, and might not unreasonably assist in the improvement of the tanks by contributing half the cost. It then need give no exemption for any improvement effected, as it will derive only half the rental value of the total increase which the improvement may ultimately secure.

Allotment of definite funds suggested.

40. It is of course a large undertaking to assist in the improvement of village tanks, and the best plan would be to allot a definite annual sum for this purpose. It occurred to me that the additional rate of 2 per cent. on the land revenue, which is taken in this province as a local cess only, might very properly be allocated for this purpose.

Appropriateness of applying the additional rate to this purpose.

The Act which imposed this rate was not ready to hand when I put this view before the Commission, but I have since refreshed my memory by reference to this Act, X of 1878, and it seems to be clear that this fund can easily, under the existing law, be so utilised.

The preamble runs "whereas in order to defray the expenditure incurred and to be incurred for the relief and prevention of famine, it is necessary to make a permanent increase to the annual revenues, and it is therefore expedient to provide, in the territories administered by the Chief Commissioner, for the levy of additional rates on land, &c., &c."

Section 4 runs "the proceeds of all rates levied under this Act shall be carried to the credit of the Local Government."

Section 5 runs "from the sums so credited, the Chief Commissioner shall from time to time appropriate such amount as the Governor-General in Council may direct for the purpose of increasing the revenues available for defraying the expenditure incurred or to be incurred for the relief and prevention of famine in the said territories; or if the Governor-General in Council so directs in any other part of British India. The residue of the said sums after such appropriation may be applied by the Chief Commissioner, subject to the control of the Governor-General in Council, to such local works likely to promote the public health, comfort or convenience as the Chief Commissioner thinks fit."

No legal objection to this course.

Which would also be popular.

Now it may be doubtful whether irrigation tanks could be held to fall within the definition of works "likely to promote the public health, comfort or convenience," but funds used for such tanks might certainly be held as fit appropriations for the "*prevention of famine.*" I am unaware exactly how these Local Funds are treated in the accounts, but they appear to be credited to the Provincial Funds, and the manner in which they were used appears to have been lost sight of. These local rates amount to Rs. 1,80,000 annually, and the appropriation of this sum to the improvement of protective village works appear to me to fulfil the avowed object for which they were imposed in the very fullest sense. The levy of this rate has always been unpopular with the people, but it would greatly reconcile them to it if the funds were spent for village improvements.

Creation of an Engineering Branch in the Agriculture Department.

41. If we are to undertake this work, a special establishment with an Agricultural Engineer at the head of it would be very necessary. The fund should reach two lakhs in a few years' time, and half a lakh would give us an efficient establishment specially trained for the class of work required of it, leaving a lakh and a half for local improvements. On the basis that proprietors contributed half of any outlay required with the aid of *takavi*, or otherwise, an annual expenditure of three lakhs would be the outlay possible for small works—an amount which is by no means to be despised. In allotting the funds to the several divisions and districts, it would not be necessary to allot to each division or local area the precise amount of the rates they paid. A fund which is raised for the prevention of famine would naturally be devoted to areas which are most insecure; but it would be wise policy to devote a portion to the bunding of fields where such work was expensive, to the reclamation of ravine land, or to small *tars*, allotments being made, of course, on the basis of an equal expenditure of private money on the work. No district should be left out in the cold altogether, but money should preferably be devoted to cases in which the total cost of the improvement was beyond the means of the private owner.

Powers of acquisition for private tanks subject to certain safeguards.

42. As already stated further back in this note, a private owner who is quite ready to make a tank or *tar* is often impeded by want of command of the land. The improvement will submerge some one else's land, or the *tar* or contour drain has to cross over the fields of a neighbouring village. Negotiations, even when backed by the moral suasion of a Revenue Officer, are liable to fail. It will therefore be necessary to give power of acquisition in such cases with

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safeguards that the advantage to be gained by the improvement by the village community benefited must be proved to be largely greater than the loss to the individuals or the community who are deprived of land, that the compensation calculated is deposited with the Revenue Officer before the work is commenced; and with sufficient security that the work will actually be carried out. I do not think that it would be found impossible to devise safeguards of this kind, and many useful projects might be carried out which are now impossible because of the dog-in-the-manger attitude of the person whose land is prejudicially affected, perhaps very slightly, by the proposed improvement. It would also be necessary for the owner of the tank to acquire land for a distributary channel when private negotiation failed.

Cases in which Government should acquire a private tank.

43. There is still one other case to be considered,—that in which powers of acquisition should be reserved to the State. If the owner refused to repair a tank, or to take *takavi* for the repair, or to find half the funds in supplement of a grant-in-aid, it might be necessary in extreme cases for Government to acquire the tank. In that case it would be necessary to revise the terms of the settlement in such a way that the rental value derived by reason of the tank might be separated off and made payable directly to the Government. The threat of acquisition would suffice to bring most proprietors to their senses. Our hands require strengthening in this matter.

Temporary acquisition in time of drought

44. Another form of acquisition would be a temporary acquisition in an emergency, if the landlord refused to give water to those entitled to it at a time of drought. This power would be useful upon occasion, though its exercise would only be possible in a few cases. Action under it would be a matter of a few days, while inquiry would take time, and could not be entrusted to subordinate officials

Proposed action need not be demoralizing.

45. Some officers are afraid that State aid and interference of the kind suggested will demoralize the people and discourage private effort. This depends on the discrimination with which the aid is given; and under the system which I have roughly sketched above, aid will only be given to those who help themselves; while the unworthy and incapable are to be ousted, not aided. At the same time encouragement must be given to improvements carried out entirely from private funds. There are two sorts of encouragements usually recommended: one is exemption of improvements, the other free distribution of *takavi*.

Exemption of improvements.

46. I understand that in some provinces perpetual exemption of improvements is already the rule, while the late Famine Commission recommended its general adoption.

With much respect I venture to dissent from this proposal. The value of an exemption from assessment as an inducement to improve is, in my opinion, exaggerated. To begin with, it is not an inducement at all. The inducement is the profit to be made from the improvement. The fear of assessment may be a deterrent. Exemption is, therefore, the removal of a deterrent. A man with a revenue-free holding in perpetuity has no such deterrent before him, yet experience does not show that he spends more on improvement of his land than his fully-assessed neighbour. Quite the contrary, he spends less because he has not the same pressing desire to increase his income.

I need not enlarge upon the fact that the effect of such exemption is obscured by the enhancement imposed on general grounds; this has been made abundantly clear by the evidence. Our assessments are so light that the difference made by the exemption cannot affect a man one way or the other.

Perpetual exemption deprecated.

Apart, however, from this question, it is unreasonable that a man who once spends a comparatively small sum on applying certain natural facilities should be for ever exempt from paying the State a share of the profits to which these natural facilities as well as his application have contributed. At any rate, the privilege of perpetual exemption should be confined to works of most exceptional cost and enterprise. Some recommend a fixed term of exemption in place of the present rule—the exemption for the remaining term of settlement and for one settlement after.

Resumption of exemption should always take place at settlement.

There is great administrative convenience in terminating the exemption with the expiry of a settlement. For if you had a fixed term of years, and 50 people made wells in a village in different years, you would have to prepare a record showing the enhancement to which each was liable and the date on which it would come into force. In that event if the people were tenants, there would have to be a perpetually progressive assessment of irritatingly petty sums. To judge from our experience of ordinary *muafis*, there would be constant cases of delays in bringing these extra demands on to the books, with consequent annoying recoveries of arrears.

A fixed minimum term is desirable.

47. It would be preferable to fix a term—say 30 years (or 50 years in the case of large works) and to the end of the settlement current at the expiry of that period. This would be a most ample time for such improvements as wells, *bunds*, and small tanks, *i.e.*, such improvements as would be in the capacity of a tenant.

Special rewards for large works.

For the large works I would recommend exemption as above-mentioned, retrospective remission of the revenue of any land submerged by the tank, and as an additional and sentimental inducement a grant (*lukum* or *ubari*), either, as proposed by Mr. Sly, of a perpetual quit-rent on the and improved, fixed at a proportion three-fourths or seven-eighths of the *kamil-jama*, or, as suggested by Mr. Low, of a smaller revenue-free grant for two lives fixed at some proportion of the area improved. This concession would apply to plot-proprietors and malguzars, but not to tenants. The *muafi* concession would be conferred with retrospective effect as soon as the tank was completed, and would continue so long as it was maintained in repair. The concession would also be personal to the grantee and his heirs, and should not continue in favour of a transferee. It is seldom that an owner of this kind voluntarily transfers the land he has improved. If he loses it, it is because he is involved in debt, and he loses it almost always below its full value. Moreover, the revenue-free grant is intended to have a sentimental value in the eyes of the man who made the improvement and his family. It is not intended as a pecuniary benefit with a transferable pecuniary value.

Value of which should not be alienated outside the family.

Takavi for land improvement small operations hitherto.

48. The next point to be considered is *takavi* for land improvement. With the exception of the year 1896-97, in which famine loans to the aggregate amount of 11¼ lakhs were given out. *Takavi* operation for land improvement have always been on a small scale.

Encouragement of *takavi* discussed.

Originally, no doubt, applications were few, and only small allotments were asked for. Later on perhaps small allotments have discouraged applications. Applications are made very commonly in the early hot-weather. The financial year is over before the inquiries are complete, and some time elapses before the next year's allotment is made known. Delays of this kind are one discouragement, but I don't think that they count for much. A large loan is not to be negotiated in a hurry, even in the case of a private money-lender. It is also the fashion to say that severity of collection affords a discouragement. Loan instalments should always be suspended if the season is such as to require suspension of revenue, but there is little advantage in making the instalments repayable in the next year. If one instalment has to be suspended, it should be postponed till after the last instalment. Save, however, for severity in a year of losses, I do not think that the demand for repayment is much of a deterrent to men taking loans. The real deterrent consists in making the first instalment repayable too soon. The rules permit of the first instalment being fixed three years after the receipt of the loan, and this procedure should be followed, and the term extended to five years when necessary. The rules also allow a maximum term of 35 years for repayment. So long a term is only necessary in the case of very large loans given for expensive works. Fifteen years should be the ordinary term. It has been the fashion to fix three, five, nine and sometimes ten, but more often the shorter periods. The applicant is asked when he will repay the loan. A borrower is always sanguine about the time in which he can repay a loan, and he mentions a short one as an inducement to getting it. Very long terms are unnecessary and risky in the case of tenants of short standing or small status, and the security for advances is weakest when the country is deteriorated and the demand is for tenants and not for land.

Too early repayment is the real discouragement.

Amount of advance allowed.

49. The Land improvement Loans Act requires certain formalities, such as local notification and the hearing of objections (section 5), and the Government is bound to be satisfied that the security offered is adequate. It has been stated in evidence that the rules do not permit of sufficiently large advances being made. But Rule 7 allows the loan to be made to the full value of the land for which it is taken, or of the landed security offered by sureties, and the Commissioner may even sanction a larger amount than this.

It is true that in the case of occupancy and ordinary tenants, Rule 9 requires the joint personal security of not less than three occupancy tenants, and the loan cannot (without the Commissioner's sanction) exceed three times the total rental of the tenants who offer security. But since that rule was framed the Tenancy Act, sections 46 (3) and 70 (3), specially provides for the sale of the holdings of occupancy and ordinary holdings in recovery of Government loans. This therefore enlarges the security which such tenants can offer whenever their land has a market value.

The land for the benefit of which the loan has been granted can be sold free of all encumbrances, *vide* section 7 (c) and the proviso to that section. The only question is what is the land included under that term. When a tenant improves one field in his holding, does the whole holding constitute the land for the benefit of which the loan has been granted, and in the case of a malguzar does the term comprise the whole village? I am not aware that this question has ever been judicially raised, but it is one that might be raised at any time, and one therefore which should be made clear.

Rates of interest.

50. Another matter in connection with these loans that is often raised is the interest. The Chief Commissioner may sanction loans at a lower rate of interest or free of interest altogether, and the Commissioner may order that the running of interest may be delayed "until a date which shall precede by at least six months the date fixed for the repayment of the first instalment of principal." Otherwise the interest runs from the date of the loan and is not less than 6¼ per cent., and the Deputy Commissioner may charge 12½ per cent. on any instalment of principal or interest that is not paid in time. I have no belief in penal interest, but in all other respects the rules as to interest appear to be sufficiently liberal. The rate is well below the prevailing rates at which money can be borrowed from private lenders, and has certainly not deterred would-be borrowers.

Moderate but penal interest is a mistake.

More powers should be given to the Deputy Commissioner.

51. On the whole, then, it appears that the rules offer sufficiently attractive terms if full advantage is taken of them, but it might be well to give more power to the Deputy Commissioner. The necessity for obtaining sanction may deter him from offering more favourable terms, and gives the impression that the more liberal concessions are to be applicable only to exceptional cases.

A great field for the gradual extension of loans.

There is, in my opinion, a great field for the extension of land improvement loans in this province, if the terms for repayment are made more liberal than has been the existing practice, and if these terms are properly published in the villages. But I would advocate a gradual increase. It is a mistake to press loans on unwilling recipients, and just at this moment the people are impoverished and indebted, and unwilling to add to their obligations.

Fixed annual allotment for a term of years should be made available.

In normal years the sums advanced over the whole province seldom exceeded Rs. 30,000, but of late years the famine loans, which are really land improvement loans offered under special terms, have confused the accounts. I would estimate, however, that we could in the near future distribute four or five lakhs annually over the province, but progress must be cautious, for there is great risk that loans would be misapplied to payment of creditors, and supervision becomes difficult as loans become very numerous. We must also be prepared for disappointments. If an annual allotment of five lakhs were made, it would never do to reduce it, because in the first two or three years it was not fully distributed.

Special officer not generally required.

I am not much in favour of a special officer being appointed for the distribution of these loans. The Deputy Commissioner and his Executive Assistants should be able to do what is required, but if in any district or at any particular time applications for the loan become very numerous, it would be easy to detail an officer on special duty to deal with them.

Aid other than pecuniary to private works.

52. Reference has been made in the course of the Commission's inquiry to the advisability of lending the services of professional well-borers in tracts where it is desired to push well-irrigation. This would be a kind of work on which expenditure would be justified from the Provincial Improvement Fund, provided that such a staff was procurable, at all events in the beginning. If the staff was found to be satisfactory, there is no reason why well-to-do people should not pay for its services at a tariff to be fixed by the Agricultural Department in all cases in which the operations were successful.

Especially useful in the case of Court of Wards.

Similarly, if we have an Agricultural Engineer with a skilled establishment, it might be put at the disposal of private individuals for the purpose of giving advice, or of making surveys, a charge being made for these services to be credited to the Fund in the case of all well-to-do persons. Services of this kind would be specially valuable to our Courts of Wards, which are often unable to undertake important works for fear of wasting their wards' money on some ill-considered or ill-carried out scheme. The large solvent states, the only ones in which important projects can be undertaken, could well afford to pay for this professional assistance.

Summary of recommendations regarding private works

53. My recommendations under head III of this note may therefore be summed up as follows:—

I.—The constitution of a Local Famine Prevention Fund to which would be credited—

(a) The proceeds of the present additional rates.

(b) Any fees paid by Court of Wards' estates or by private persons to the Agricultural Department for advice, surveys, or professional assistance.

(c) Any fines imposed on malguzars who refuse to carry out their obligations regarding tanks.

II.—The addition of an engineering branch to the Agricultural Department to be charged to the Fund mentioned above.

III.—The balance of the Fund to be devoted to grants-in-aid for agricultural improvements equal to half the cost of such improvements.

IV.—Enlarged powers of land acquisition for the improvement of village tanks, and to give temporary control over distribution of water in emergent cases in times of drought.

V.—Exemption of improvements for a fixed minimum term of 30 years or 50 years according to circumstances.

VI.—Special rewards in the shape of proportional quit-rent or revenue-free grants for specially costly works on a scale to be determined, to be given on completion of the work with such retrospective effect as is necessary.

VII.—The encouragement of *takavi* by longer terms for repayment, postponement of first instalment to three or five years, and by suspension of instalments in the event of crop failure, effect being given to each such suspension by putting on all subsequent instalments by one year.

IV.—*The immediate practical steps to be taken to give effect to the objects desired.*

Necessity of framing a complete programme with an order of urgency.

54. The construction of irrigation works which the Government may decide, upon the recommendations of the Commission, to undertake as State works must necessarily be spread over a long term of years, and such funds as may be allotted annually should therefore be devoted to the most urgent works, that is to say, to works in the tracts which most need protection.

Investigation in tracts not protected or inadequately protected by projects already prepared.

The selection of tracts to which money should first be applied must therefore be the first duty. Having done this, we shall see which of the projects already prepared fall within these tracts. If any of these tracts

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are either not protected at all, or are imperfectly protected, investigation must be directed to projects in them if such are possible.

Determination of certain principles.

Construction will follow in the same order, but the programme must be well ahead of construction, so that in the event of famine occurring, relief works may be selected to the best advantage. The projects already drawn up in a preliminary stage must be put into a final shape, if local examination and consultation with Revenue Officers show that they are worth constructing. But information has to be obtained and a decision made in respect to such matters as the duty of water, the standard tank capacity to be adopted with reference to the rainfall, the degree of protection to be aimed at, and the proportion of protection which will stave off famine in any tract or group of villages.

Early completion of works in Chhattisgarh begun in the famine.

55. So far as immediate construction is concerned, we have in Raipur and Bilaspur a number of unfinished works commenced in the famine which should clearly be completed. We have learnt from the Chhattisgarh officers that these works are eminently suited to give protection to types of villages which are most liable to failure, even though they may not be situated in the tracts over which as a whole failure was most general. They are ready to hand; the fresh expenditure to be incurred is not large, and they will give us admirable experience. Let them be completed as soon as is possible. But let not completion of projects from preliminary to final stages or investigation come to a standstill meanwhile.

We must have a district irrigation scheme just as we have a district road scheme, and just as roads in the road scheme can be readily transferred on to the famine programme, so will it be with works on the irrigation scheme.

These are the measures necessary with reference to major works to be executed by the State; but there is an extensive village work programme to be prepared, which will include the minor works capable of being constructed as village works in famine time, and of being gradually carried out from the local Famine Prevention Fund in anticipation of famine.

Early introduction of measures discussed in Part III.

56. The measures summarised under Part III of this note in paragraph 52 are capable of being introduced at a very early date, and there need be no delay in respect to all which do not require legislation; that is to say, all except those which refer to the acquisition of land for private works.

But any legislation necessary will require caution.

Legislation will certainly be necessary both for the control and management of State works, and for obtaining the powers of acquisition which I have indicated in respect to local works. But this is too important a measure to be hurriedly pushed through. It is possible to indicate general lines; but further experience and much discussion are necessary before details can be determined. Opinions may, however, be invited on the general lines, and I should be disposed to recommend a short special Act in preference to amendments of existing Acts. Our Land Revenue Act is already encumbered with unwieldy interpolations and amendments, and the inter-dependence of public and private irrigation in this province will make it difficult to meet its needs by amendments or additions to the Northern India Canals Act.

General sketch of district possibilities.

57. I will now bring this note to a close by roughly indicating for each district what scope exists for extension of protection in one shape or another to the distinctive parts of each.

Saugor.—There are 25,000 acres of rice in this district, of which all but a small fraction is irrigated. Local inquiry is needed as to whether this can be usefully protected or extended, and whether rice can be substituted for some of the area (82,000 acres) cropped with the hill millets. But apart from this the chief scope lies for improvements of *kharif* cultivation, cotton and *juar*, on well-devised sites; for the extension of well-irrigation (over 3,000 acres of wheat were irrigated in 1900-01); and, lastly, and chiefly, for the extension of bunding of wheat fields. Improvements are especially needed in the Khurai Tahsil, where past failures have been most severe, and *kans* has most extended.

I believe also that the Khurai Tahsil comprises most land of the kind for which canal irrigation has been attempted in the adjoining districts of Bundelkhand, by means of the Betwe Canal, the results gained by which would be of much interest.

Damoh.—This district is divided into well-marked *haveli* and *non-haveli* areas. The central tracts, which are chiefly black soil whett land, offer the most favourable field for the extension of bunding, which has already made some progress. There is also scope for well-irrigation to be extended.

In the *non-haveli* portion of the district there is a rice area of over 70,000 acres, while another 70,000 acres are cropped with hill millets. There is considerable scope for the irrigation of this rice land, and of the wheat land adjacent to it.

Jubbulpore.—There are no less than 220,000 acres of rice land in this district, of which about 120,000 acres are doubled-cropped, and provided for by the bunded fields. For the rest irrigation is desirable, and it should be possible to convert into rice land, r to substitute better cropping for some of the area (000 acres) now growing *kodon* and *kutki*. Most the wheat area is protected by *bunds*. But these be further extended, and the two systems can be developed.

The tracts most liable to suffer from drought are the Murwara Tahsil and the Kundum and Bargi Circles.

Mandla.—Agriculturally the most backward district in the province, over 60 per cent. of the population being aboriginal. As about half the district is held on rayatwari tenure, the State has special obligations in respect of it. Over a limited area it has land like that of the Jubbulpore *haveli*, but for the rest there is a great deal of poor hilly land. There are over 80,000 acres of rice and 220,000 acres of hill millets. There exists very considerable scope for additional rice cultivation; *juar* and cotton are practically unknown in the district, and their introduction seems desirable. Well-irrigation is very scanty, and the people have very little capital; but the district suffered much more in 1896-97 than in 1899-1900.

Seoni.—The southern and south-eastern portion of this district contain rice land akin to that of Balaghat and capable of being greatly secured by irrigation. In the rocky Lakhnadon Tahsil it might be possible to extend *juar*, and perhaps cotton; and there should certainly be room in the valleys for much more well-irrigation. The *haveli* tract on the Chhindwara border might offer a field for bunding. This and a corner of the district situated below the ghâts did fairly well in both famines.

Narsinghpur.—Bunding of wheat is well known in this district and is capable of much extension, especially in the Gadarwara Tahsil. In the south of the district at the foot of the Satpuras there is a light soil tract which offers a field for irrigated rice. The area now unirrigated is 26,000 acres, and this part suffered greatly in the droughts, while the central area of the district escaped very lightly. There is a light soil area in the Gadarwara Tahsil which it might be possible to help by *tars*.

Hoshangabad.—In this district the protection of the wheat crop should be the first consideration, chiefly by bunding, and to some extent by wells and tanks. The Sohagpur Tahsil contains the lightest soil, and the so-called black soil of the tahsil might be found to take irrigation, if any good projects can be found. In the west of the district better cultivation of *kharif* crops is a possible improvement deserving encouragement. The district became too dependent on wheat, and has suffered for this. Rice is not important; but there is a strip of land along the Tawa in which wells might be increased.

Nimar.—Well-irrigation for the cultivation of wheat in the valleys, and for the protection of the *kharif* crops elsewhere, is practically the only form of irrigation which is promising. Within limits this is the part of the province in which wells can be pushed most.

Betul and Chhindwara above the Ghâts.—Wells are capable of extension in these districts, and in the level light soils there might be much scope for the introduction of rice with irrigation. Experiments are necessary. Northern Betul below the Ghâts should offer some good tank sites. In the level portions of the plateau in Betul there is a very good field for extending well-irrigation, and sugarcane cultivation might revive. The Chaurai and Linga tracts of Chhindwara contain some level wheat land similar to that of the Seoni *haveli*, in which bunding might be tried. The area of rice in these two districts is insignificant; that under hill millets is very large.

The Sausar Tahsil of Chhindwara below the Ghâts is similar to the cotton-*juar* country of Nagpur, and affords scope for well-irrigation.

Wardha.—The Arvi and Wardha Tahsils are cotton-*juar* tracts; well-irrigation might be extended, but nothing else can be done. In the Hinganghat Tahsil, there is a *rabi* area in which the bunding of fields might be tried as an experiment.

Nagpur.—In the west of the district there is a cotton-*juar* tract. There is good well-irrigation which can be extended. In the centre and south of the district there is a large area of wheat land, part of which is favourable to bunding. The east of the district presents features similar to those of the adjacent rice country, and there is scope for rice irrigation.

58. *Bhandara, Balaghat, Chanda, Raipur, Bilaspur, and Sambalpur.* These are the great rice districts of the Province, and it is in these that the greatest field is open for tank irrigation, large and small. So much has been said about them both in this note and in the evidence before the Commission that it is unnecessary to repeat details here. But a few words are necessary in respect of Sambalpur. That district is composed almost entirely of light soil. Its climate is on the whole more secure, since the cyclonic storms of September and October, which move away to the north-east and leave the bulk of the Province untouched, frequently give Sambalpur rain. The configuration of the country and its soil afford facilities for irrigation, and the attitude of the people towards irrigation more resembles that of the Wainganga districts than the rest of Chhattisgarh. Unlike Raipur and Bilaspur, the district is not hampered by the remains of the *lakha-bhata* system which so impedes improvements in Raipur and Bilaspur; but, on the other hand, its tenure is such that the private owners have no interest in making tanks except such as improve their own *bhogra* or home-farm. Large irrigation works are perhaps less necessary in Sambalpur than elsewhere, but the districts should not be entirely neglected in any scheme of improvement which may be adopted for the Province at large.

Special remarks regarding Sambalpur.

Lakha-bhata system in Raipur and Bilaspur.

59. As regards the scattering of fields which has resulted from the old *lakha-bhata* system in Raipur and Bilaspur, it is difficult to know what to suggest. The present law would recognize the exchange of tenures which a final redistribution of fields would entail; and if all the parties concerned would agree, the operation would be legal. But the idea of such a distribution has faded, though the results remain, and the difficulties in the way of a compulsory redistribution would intensify several hundred-fold those which are encountered in the division of *sir* land in a partition proceeding. Gradual action by pressure brought to bear on malguzars seems the only course, but if the idea caught on it might rapidly develop.

Statements attached to this note.

60. Two statements are attached to this note showing, respectively, the details of irrigation in 1900-01, and the total figures of certain distinctive years.

In 1900-01 the decrease in irrigation is in great measure due to the decrease in rice cultivation and want of seed and resources. In Chhattisgarh the returns of the last few years have been disorganized by settlement operations and famines, and confusion has arisen with reference to the area which is irrigated by percolation (the *pajra*). In other parts of the Province, however, the statistics are more reliable, and show how irrigation is resorted to in normal years and how village tanks are apt to fail when they are most wanted in years of drought. A very brief memorandum showing the advantage in crop outturns which embankment or irrigation will give is also added.

BENGAL.

Mr. C. E. A. W. **Oldham**, Collector of Gya.

(*Bankipore, 24th October 1902.*)

Mr. C. E. A. W. Oldham.

1. *Q.* (*The President.*)—How long have you been Collector of Gya?—For nearly five years.

2. *Q.* Before that were you in this part of the world?—Yes. I have served in Shahabad, in Darbhanga and in Monghyr also.

3. *Q.* And you have probably had some experience of famine?—Very slight. In 1892 in the Monghyr district I was in charge of a small famine relief circle. The distress was not severe.

4. *Q.* Would you say that there was any place in your district where there is a reasonable fear of famine, or are you practically immune?—I don't think we are immune, but we are almost immune at present. There are one or two tracts in the district in which I think famine might occur.

5. *Q.* And what is the characteristic of these districts? Is it an absence of *pains* or *ahars*, or is there any deficiency of rainfall?—The normal rainfall is low in our district as it is in the Shahabad district. Secondly, the means of irrigation in these tracts are few and unreliable; the lands are high; the soil is not very productive; and if a good rainfall does not occur, the reservoirs and artificial channels for irrigation are not filled, and consequently the crops suffer.

6. *Q.* What would be the remedy for this?—The only remedy is the extension of the system of artificial irrigation by channels, reservoirs and wells.

7. *Q.* The extension of channels and reservoirs has probably its limits; has it not? Has all been done that can be done?—I think not in the case of channels, and in the case of reservoirs also, I think, there is room for extension and improvement.

8. *Q.* These channels; are they derived from the streams coming from the Gya hills?—From the hills of Chota Nagpur which fringe the Gya district.

9. *Q.* And which are torrential?—Quite so, with the exception of two or three streams which are more or less perennial. The Punpun generally has water all the year round, though it has very little in the hot weather; and there are two other small streams which retain their water.

10. *Q.* The Punpun passes through Patna also?—It does. It is a small river, but still it retains water, owing to the soil through which it flows.

11. *Q.* These *ahars* and channels are very ancient, I suppose?—They are, no doubt.

12. *Q.* They are entirely of native-making? They have not been suggested by us?—Not at all. By far the greater part of them date from before the British rule. The tendency now is for these channels to fall into disrepair owing to the disintegration of proprietary rights. Formerly when these channels were made they were made by the order of large zamindars who owned large estates and had large powers—powers which no zamindar at the present day wields or can possibly wield under our laws. For instance, the Maharaja of Tikari was all powerful in the district one hundred and fifty years ago, and in the time of previous Maharajas, who had similar authority, the greater portion of these channels were made, though we have no historical records of this. Now it is impossible for such new channels of this description to be made by any zamindar, because he will have to carry them through the lands of other zamindars who will not agree, or who will obstruct in some way or another.

13. *Q.* Then that state of things is at least partly due to this unfortunate want of cohesion among them in recognising common objects?—It is the state of society at present. It is a lamentable condition of things no doubt, but it is a fact that no two neighbouring zamindars will combine together to help in a work of common benefit.

14. *Q.* And that the zamindars in this great sub-division of land are not as large zamindars as there were formerly?—Not nearly. This disintegration is going on daily. It is admitted by all.

15. *Q.* What is the remedy?—Disintegration we cannot prevent. The only device for getting round the difficulty is legislation.

16. *Q.* Legislation in the direction of making the authority of the Collector more supreme?—Of enforcing the up-keep of these channels on which the cultivation of the soil or of $\frac{9}{10}$ths of the soil of the district depends, maintaining them, repairing them and extending them where necessary. Without legislation this cannot be done. It is impracticable at present. I know many cases of *pains* which have fallen into disrepair owing to those causes, and which have either become unused, or partly unused, or so largely silted up that they are rendered less serviceable than they used to be.

17. *Q.* And would you give the Collector summary powers to levy a fine in order to get the work done or force the men to carry it out?—I would give the Collector such power as this that he should be in a position to say to certain zamindars who own the lands through which these channels pass, "repair them," and if they did not carry out his instructions, he should be empowered by law to have the work carried out himself and to realise the cost from those zamindars in proportion to their interests.

18. *Q.* Do you think the effect of such a law being passed would be to put them on their mettle. If not, it would give the Collector a great deal to do?—I think it would have that effect also.

19. *Q.* Do these works really require some professional advice to manage them?—They do in their inception. That is another point on which legislation is required. No new *pain* should be constructed unless it be approved by some professional man.

20. *Q.* I gather it would not be very easy to construct a new *pain* without interfering with the rights of some other zamindars?—It would be difficult. Objection would no doubt be raised by the zamindars having riparian interests further down. They would perhaps go into the Civil Court for an injunction or for damages.

21. *Q.* (*Sir Thomas Higham.*)—Can they get an injunction to prevent them?—I think so. Certainly. The Civil Court has full powers to interfere in such matters.

22. *Q.* They can prevent a *pain* being constructed?—They can issue an injunction.

23. *Q.* Then the case goes up to the High Court?—Frequently.

24. *Q.* These *pains* are little channels leading out of nullahs, I suppose?—Leading from the rivers.

25. *Q.* Big and little?—Yes.

26. *Q.* Does the zamindar put a *bund* partially across the nullah?—It is not necessary at all. (The witness illustrated his meaning to the Commission.)

27. *Q.* Is the zamindar allowed to put a *bund* across a *pain*, or partially across it?—In many cases they have acquired what is called a prescriptive right to do so; but if any zamindar were now to bund up a *pain*, where it has not been the custom to make a *bund* hitherto, the other proprietors would at once go into Court and get it broken down.

28. *Q.* (*Mr. Muir-Mackenzie.*)—And do they, as a matter of fact, ever attempt to do that?—Very rarely. Occasionally they do. Only the wealthy zamindars are able to risk it.

29. *Q.* (*The President.*)—Then I suppose the *ahar* does double duty in irrigating the lands and having its own bed irrigated? Is that so?—It is, Sir. An *ahar* fills in July and August and part of September. It is then easy to irrigate paddy and other crops, and as soon as the water is all used up, *rabi* crops are grown in the bed of the *ahar*.

30. *Q.* And to which is the greatest importance attached—to the paddy or the crops grown in the bed?—Paddy, as far as my experience goes. No doubt a very excellent *rabi* crop is produced in the soil of the bed, but it is a very small one.

31. *Q.* Are wells kept up in the neighbourhood of these *ahars*?—I have not noticed that in the Gya district.

32. *Q.* (*Mr. Muir-Mackenzie.*)—You don't find that people choose sites for their wells by preference in their neighbourhood?—No. *Ahars* are generally made at a distance from the villages.

33. *Q*. And the wells are generally close to the village?—In my district, Gya, wells are only generally used in proximity to the villages. In what is known as the *dihans*. Well irrigation outside village lands is very rare.

34. *Q*. (*The President*.)—Do you know whether any applications are made for advances to have *ahars*, *pains* or wells?—Ostensibly for this purpose there are numerous applications, but the greater part of the money is spent otherwise in such cases.

35. *Q*. Is there any system of *takavi* advances for wells?—There is no special system for wells.

36. *Q*. In your district does irrigation by wells occupy an important place?—No. *Pains* and *ahars* are far and away ahead. I calculated that about half the cultivated area in the district is irrigated from *ahars* and tanks. Tanks are very few in the Gya district, but nearly half, if not quite half, of the whole cultivated area of the district is irrigated from these *ahars* and tanks.

37. *Q*. And then how much irrigation is there from the *pains*?—I cannot exactly say.

38. *Q*. About a quarter?—Quite, - perhaps a third. I would not be sure; I have not calculated this.

39. *Q*. Would there not be a feeling of confidence, if you had a well for the *ahar*, that in years of drought it would stand out better?—A well irrigates such a small area.

40. *Q*. Do you know how much it is in this part of the world?—A well will not irrigate more than 25 *bighas* here. The average area irrigated by wells is about 5 acres.

41. *Q*. Is that all the year round?—Yes.

42. *Q*. (*Mr. Muir-Mackenzie*.)—Does that mean a well of a single *mot* or more?—A well of one *mot* will irrigate about 5 acres.

43. *Q*. (*The President*.)—Do you think any assistance is to be rendered to irrigation by a more liberal system of *takavi* advances?—I don't think it is a satisfactory system. I don't think it would be satisfactory.

44. *Q*. And why, please?—Because these advances are, as a general rule, not spent on those works for which they are ostensibly taken.

45. *Q*. And can they not be looked after?—It is very difficult to ensure control, especially where you have got a large number of advances. It is impracticable, in fact.

46. *Q*. Would it be worth while to have a special officer or some one under the Collector for this purpose?—I don't think so. I would not advise it. I would deprecate any further special establishments. They are only a source of harassment.

47. *Q*. Do you think it would be a good thing to have a special officer going round the district giving *takavi* advances?—I think that would be useful. Even in my district, I think, it would be useful to have a special officer going round and giving advances.

48. *Q*. (*Sir Thomas Higham*.)—What would it be spent upon?—On the making of wells, repairs of *ahars*, cleaning out of channels, *pains*, etc.

49. *Q*. (*Mr. Muir-Mackenzie*.)—I don't quite understand why you push the advances so much in Gya if you deprecate the extension of the system?—I don't deprecate the extension of giving advances. I deprecate the appointment of a special establishment.

50. *Q*. (*The President*.)—I see you say in your note that "a system should be introduced by which sanction to the grant of advances could be more promptly given and the cash paid personally by a gazetted officer at convenient centres." You see no other practicable way of doing it or any better way than this?—I think it is one of the means to the end that we want to attain.

51. *Q*. (*Sir Thomas Higham*.)—You speak of one canal that you have in continuous flow; that you call the Patna-Gya Canal?—Yes. That is one of the branches of the Sone system. It irrigates a comparatively small area in the Gya district.

52. *Q*. And on the Sone Canal do they take the rents in share of produce (*bhaoli*)?—In some parts, but the rents are generally cash in canal-irrigated areas.

53. *Q*. Do you think, as regards the water-rates on the Sone Canal, more might be taken from the occupants?—I think that the compensation from the canal irrigation in the way of additional produce is more than what they pay for the water. More could be taken perhaps from them.

54. *Q*. In the case of the non-occupancy tenants there is no limit to the power of the landlord to raise the rent. Is there?—There is a limit. He would have to go to Court I think.

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55. *Q*. Can landlords enhance the cash rents on their non-occupancy tenants?—There are provisions of the law by which they can.

56. *Q*. Have they risen in consequence of the water advantages?—Yes, very largely.

57. *Q*. Would not that point to the fact that occupiers' rates are not as high as they might be?—I will not say that they are increasing now on those lands which have reached their full degree of productiveness.

58. There is more competition in the way of applications for water now than there was formerly? - Certainly.

59. *Q*. So that if the rate was raised people would still come forward and want the water?—I think they would

60. *Q*. You have very strong views as to the rates being too low?—I will not say they are too low.

61. *Q*. You say that the cultivation in the district depends on the tanks and *ahars*?—Half the artificially irrigated cultivation.

62. *Q*. That includes the *pains* too?—No.

63. *Q*. What proportion is dependent on the *pains*? - Mr. Muir-Mackenzie also asked me that question. I am not in a position to say exactly, but I should say one-third roughly.

64. *Q*. One-third of the artificial irrigation?—Yes. 56,000 acres are, I think, irrigated by the canals.

65. *Q*. You say that one reason for preventing the construction of new *pains* is that the holdings have become very much smaller, and that the landowners have much less power. Supposing that could be got over, would there not be an objection on the part of all the owners of existing *pains* to any new ones being constructed. Would it be possible to construct any more without interfering with existing rights and privileges?—Yes, it would. There are some streams from which no *pains* have been taken off at all as yet.

66. *Q*. There are some?—Yes. There are some places, moreover, high up the streams where a *pain* might be taken off and no objection would be raised.

67. *Q*. Then there is room for the extension of *pains* if you got over this difficulty?—There is room. There is room for still more important improvement in the way of repairs to, and maintenance of, existing *pains*.

68. *Q*. Because the present owners will not combine?—Yes.

69. *Q*. Does one *pain* irrigate many independent holdings?—A *pain* may irrigate a hundred or two hundred villages or more; that is to say, a large *pain* would

70. *Q*. And there is no way of enforcing the clearances among such a number. Is there no power for management—no *panchayat*?—None.

71. *Q*. Then who is supposed to take the initiative?—The zamindars. It is their business The system in Gya is the *bhaoli* system of rents which theoretically entails upon the zamindar the duty of maintaining these works of irrigation. That has been the custom from time immemorial. There is no law on the subject; some legal provision is required. The Collector cannot interfere at present, but he ought to be able to.

72. *Q*. When you have a number of zamindars, it simply depends upon their powers of co operation?—

73. *Q*. Can any external influence be brought to bear upon them?—No legal influence.

74. *Q*. Only personal?—The days for that are in fact departing too.

75. *Q*. For that you say you would require legislation; would you not?—Certainly. It cannot be done without legislation.

76. *Q*. To whom would you entrust the duty of enforcing their up-keep?—To the Collector.

77. *Q*. Not the District Board?—No.

78. *Q*. (*Mr. Muir-Mackenzie*.)—Why do you object to the District Board?—Because it is a Board.

79. *Q*. (*Sir Thomas Higham*.)—Do these *ahars* have an excess of water coming into them?—Occasionally.

80. *Q*. Is that not a common trouble?—Fairly common, but they ought to have, and nearly always have, an escape.

81. *Q*. Do they have an escape big enough?—If it is not big enough, of course the *ahar* may burst.

Mr. C. E. A. W. Oldham.

82. *Q.* Are they ever filled from the *pains*?—Yes, sometimes.

83. *Q.* You may fill one and then the rains come down and it overflows?—Yes, that is possible.

84. *Q.* I suppose they belong to the same owners as the *pains*?—Sometimes.

85. *Q.* There is no question of paying for having them filled up?—No. *Ahars*, you will understand, are pre-eminently suited for the higher lands where *pains* cannot go. *Pains*, as you understand, can only follow the valleys of the streams, but *ahars* are intended for the high lands—what are known as *tanr* lands in the Gya district where *pains* cannot reach.

86. *Q.* Is there room for making more of these *ahars*?—Yes.

87. *Q.* What do they want, — money advances, or somebody to give them a lead?—Money, enterprise, education.

88. *Q.* Do they make many new ones now?—New *ahars* are occasionally made.

89. *Q.* You could not give any idea as to the numbers?—No.

90. *Q.* I suppose you have never had famine in the Gya district; have you?—We are supposed to have had it in 1873-74.

91. *Q.* Have you got any programme for works there?—Yes.

92. *Q.* What sort of works?—Roads, tanks.

93. *Q.* Irrigation tanks?—Tanks which would be used both for drinking and irrigation.

94. *Q.* Would it be possible to employ famine labour in clearing these *pains* out and putting them all to rights, or would that be objectionable, as being private property?—It might lead to disputes.

95. *Q.* Would the owners be able to employ labour in that way?—No doubt they would, but we would be doing work for private persons, not for the public.

96. *Q.* That is better than doing work which is useless?—We do not do work that is useless. Tanks are not useless, nor are roads useless.

97. *Q.* You have plenty of useful works to employ your labour?—Certainly.

98. *Q.* You employ labour that you have on roads?—Yes, and tanks of which we are not likely to have a large number.

99. *Q.* You propose to put in masonry heads to these *pains*?—I think that is a very urgent necessity.

100. *Q.* Would there be any great objection on the part of the owners to that?—There would be some objection, no doubt, but it should be overruled. Great distress is being caused by the non-existence of such head-works.

101. *Q.* Would they welcome heads like that to prevent damage, or would they regard it as a means of reducing supply?—The latter. They would not welcome it.

102. *Q.* Would you propose to make them even if the objection exists?—I would give them the option of doing it, and if they did not, I would have it carried out and recover the cost from them.

103. *Q.* You would do it at their expense?—Yes.

104. *Q.* (*Mr. Muir-Mackenzie.*)—With reference to land improvement loans during the last five years, I notice that the largest number was made in 1896-97,—107. Can you tell me the amount?—No, but Rs. 1,04,000 was spent on irrigation works alone,—wells, tanks, irrigation channels and reservoirs.

105. *Q.* About a thousand rupees a loan?

106. (*Mr. Allen.*)—Rs. 1,04,550 was spent.

107. *Q.* Were the loans as large as that?—That was exceptionally heavy.

108. *Q.* Take 1898-99?—There were 18 loans and Rs. 15,195 spent.

109. *Q.* That, again, is nearly a thousand rupees a loan. To whom are they generally advanced?—There are two kinds of advances. Those figures represent only the Land Improvement Loans Act. Advances are made both to zamindars and rayats, for improvements to zamindars, under the Agriculturists' Loans Act to cultivators; very rarely to cultivators under the Land Improvement Loans Act.

110. *Q.* Is tenure any obstacle?—No.

111. *Q.* Then why do you advance so rarely?—They take their loans under different Acts.

112. *Q.* But if a rayat wants to make a well, cannot he take it under the Land Improvement Loans Act?—He can if he likes.

113. *Q.* That hardly seems in accordance with the intentions?—No doubt cattle, seed and other things are the objects. I do not recall any case of a rayat applying for a loan for a well.

114. *Q.* Is that because he does not want it or because of the difficulties of getting it?—I cannot say.

115. *Q.* Are there any difficulties on account of his tenure?—No, so long as the security is sufficient. If he has a large cultivation, he can get a correspondingly large loan.

116. *Q.* And occupancy rights?—We do not make any hard-and-fast rule. Occasionally loans are given even to those with non-occupancy rights.

117. *Q.* Is there any difficulty as to the availability of the security that the rayat can afford?—No. It means delay, but there is no great difficulty. There is delay on account of the inquiries to be made by the subordinates of the Revenue Department.

118. *Q.* Can that be obviated by any change of system?—If an officer were deputed to go into the district where it was thought advances might be required with full powers from head-quarters to give loans up to a certain limit.

119. *Q.* Have no officers such powers at present?—Officers in charge of sub-divisions have these powers.

120. *Q.* Do not they exercise them?—No, not in my experience. Applications for loans come into the head-quarters of the district or sub-division.

121. *Q.* And head-quarters are often far distant from the applicant's abode?—It is not altogether the distance. The serious difficulty is the obstacles created among the mohurrirs, and until the applicant gives 10 per cent. to the men who deal with the loan, that loan is not given; some difficulty is raised.

122. *Q.* Is no alteration needed in the period of repayment of the loan or lowering of the rate of interest?—I do not think it is necessary to lower the rate of interest; it is already low.

123. *Q.* What period of repayment is usually fixed?—Agriculturists' loans are usually repayable in three years.

124. *Q.* And Improvements Loans?—It depends on the amount. Ten to fifteen years; very seldom fifteen years. The law allows up to twenty.

125. *Q.* I think the law allows repayment up to thirty years. The rules say twenty years, but they often restrict the law on this point. Would you be prepared to go up to twenty years?—No, not beyond ten years.

126. *Q.* Why do you prefer the short period?—I think the men are fully able to pay within that period.

127. *Q.* If you allowed a longer period, would you be able to give loans to somewhat poorer class of men?—We might, but I do not think it is a matter of much importance.

128. *Q.* Did you in the year of scarcity advance any considerable sum for the construction of *kachcha* wells?—No, it was not necessary. Last year was the only year of apprehended scarcity during my tenure of office.

129. *Q.* Have you ever been confronted with the difficulty that a security that is offered is subject to a prior encumbrance?—Occasionally, not frequently.

130. *Q.* A witness said that he considered that landlords might with advantage be given more facilities to secure an enhancement of their rent, justifiable in consequence of improvements effected by them. Do you think that advisable?—I do not think any further facilities than are already provided by the Act need be given.

131. *Q.* He has to go to Court?—There are two ways—by contract and by suit.

132. *Q.* If the matter is substantially beneficial to the tenant, he would have no difficulty in getting enhancement by contract?—Not if he is a good landlord and the tenant is reasonable.

133. *Q.* It would be dangerous to grant further facilities?—I think it would be wrong in principle.

134. *Q.* Why, if the improvement is a good one?—I regard it as primarily the duty of the rayat to improve his land. It is chiefly the result of the peculiar system of the district which imposes that duty on the landlord. I should

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like to see the abolition of the *bhaoli* tenure in Gya, and nothing but cash rents.

135. *Q.* Do not you think that the landlord has the advantage of a good deal of capital which would otherwise lie, to a certain extent, idle? Could it not be usefully employed in improving the land?—It could be usefully employed in that way.

136. *Q.* Another witness said that if irrigation could be introduced into a district like the Bhabua Sub-division, that the people, including, I understand, the zamindars, would not object to the introduction of a general cess?—I do not agree with that opinion. I think they would strongly object. They would regard it as a violation of the permanent settlement. Also the advantage would not be commensurate with the cess levied.

137. *Q.* Do you think that, in spite of that objection, it would be justifiable to impose such a cess if Government were convinced that the advantages were commensurate?—I think it would.

138. *Q.* Do you think the advantage could be made commensurate?—That is a matter for professional opinion.

139. *Q* Supposing a tract very imperfectly provided with facilities for irrigation were by means of a protective work placed in as good a position as the Sone Canal area. Would that justify the cess?—Certainly. In my district, in consequence of irrigation, lands which once paid annas 8 are paying Rs. 5 to Rs. 7 a *bigha,* and one zamindar in particular told me that a village which once brought him in only Rs. 3,000 now brings him in Rs. 18,000. In such instances as that the imposement of a cess by Government would be justifiable.

140. *Q.* Another subject. Do *pains* occasionally lead into *ahars*?—It is not common. *Ahars* are intended for high lands which cannot be irrigated by *pains*. Occasionally a *pain* is led into an *ahar*; then only for conserving.

141. *Q.* Can more water be stored by the construction of more *ahars* for the purpose of receiving water from the *pains*?—Yes.

142. *Q.* With regard to disputes about the rights of water in different parts of streams, do you think it would be advantageous to frame a record-of-rights?—It would be an excellent thing. It is a proposal that has been frequently made by me in conversation, but it has never gone up to Government.

143. *Q.* Do I understand that you would enforce the payment for labour on *pains* by going to the Collector to undertake the repair and to charge the cost provisionally to the zamindars? Would it not be preferable to levy a cess and that Government should do the repairs?—I would rather give the zamindar the opportunity of doing it. If Government were to levy a cess, it would mean getting a permanent establishment for the work, and our experience of establishments is that they are a source of harassment and annoyance to the people.

144. *Q.* There is no danger of the zamindars doing the repairs inefficiently?—If they did, the Collector should have it efficiently done. It would be for him to see it efficiently done.

145. *Q.* He would require an establishment for that, I suppose?—Yes, it would require an increase in the subordinate executive, but not a very large or unmanageable increase.

146. *Q.* Zamindars, in many cases, would not comply with the orders of Collectors?—Not if they know that the Collectors have authority behind to enforce them.

147. *Q.* As for commutation of *bhaoli* lands, would you not fear that the people would dislike cash rents?—They would welcome them.

148. *Q.* Do they not find that a produce rent serves them better, having reference to fluctuations of the seasons?—In the case of some zamindaris, but not as a general rule.

149. *Q.* In the matter of *pains*, do you not think it a good thing that Government should take over the management of even some of the very large *pains* for irrigating a hundred villages for instance?—The experiment might be tried.

150. *Q.* (*Mr. Rajaratna Mudaliar.*)—In the case of the zamindar whose revenue you said increased from Rs. 3,000 to Rs. 18,000 from the introduction of canal water, does he pay a proportionate increase of the water-rate?—That I cannot tell you. The rate is primarily paid by the cultivator, but the custom varies. In some cases the zamindar pays half; in some cases nothing.

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(*Mr. Allen.*)—In some cases the landlord is allowed to collect from the tenants.

151. *Q.* What is your security from non-occupancy tenants?—His cultivation, his non-occupancy right. It is usual in such cases to grant a loan to a combined number of tenants, who are mutually responsible.

152. *Q.* Where an occupancy tenant constructs a well at his own expense, does the zamindar demand an enhanced share of the produce or raise his money rent?—Where produce rents are in force, a certain proportion of the actual produce goes to the zamindar. So that if by constructing a well a rayat's fields produce a larger quantity, the zamindar naturally gets the benefit.

153. *Q.* Does not that tend to deter the rayat from constructing wells?—So far as I know it does not.

154. *Q.* As to prior encumbrances, we get certificates from the registraton officer for which no charge is made?—We don't get certificates.

155. *Q.* In other parts of India the tenants contribute labour to keep certain channels in repair. Does that custom prevail in zamindari estates in these provinces?—That is a common practice in the Gya district. As a general rule, the rayats carry out these works themselves.

156. *Q.* Unpaid?—In the better governed estates they are paid, and in the Government and Wards' estates, of course.

157. *Q.* Has the zamindar any power to enforce such customary labour?—I know of none.

158. *Q.* (*Mr. Muir-Mackenzie.*)—What is *goam* labour?—That means turning out in a body to repair a breach, for instance.

159. *Q.* (*Mr. Rajaratna Mudaliar.*)—Would legislation be necessary in the direction of enforcing such customary labour?—There is no necessity for it.

160. *Q.* Have not these *pains* been repaired by village labour from time immemorial?—I believe so. In *bhaoli* district it is primarily the zamindar's duty, and I would enforce the execution of that duty.

161. *Q.* The original construction is borne by the zamindar, but the subsequent maintenance is shared between the zamindar and the tenants?—That is a principal system in vogue in the Gya district. It is regarded as the duty of the zamindar to maintain these works in a proper state of repair.

162. *Q.* It would be regarded as the duty of the zamindar were there a record-of-rights drawn up to-morrow?—That would depend upon the Settlement Officer. I should certainly suggest it

163. *Q.* Suppose *pains* get out of order, has the tenant any right against the zamindar in the Courts under the Tenancy Act?—Not that I know of.

164. *Q.* Mr. Mylne said that the zamindars had no facilities for enhancing rents even in cases where they carried out improvements themselves at their own cost. Do you accept that?—No, I would refer you to the Bengal Tenancy Act.

165. *Q.* In granting loans do you give them in instalments or in one lump?—In instalments for Land Improvement loans.

166. *Q.* (*Mr. Muir-Mackenzie.*)—How about Wards and Government estates; have you made any improvements or *ahars*?—Many, and we have been able to extend irrigation.

167. *Q.* (*Mr. Allen.*)—Would you look at the preamble to the Board's rules for the Agriculturists' Loans Act? There is a distinct intimation to district officers there that they are not to supersede the mahajans. Has that any effect in restraining Collectors from disbursing money under that Act?—Very little.

168. *Q.* Under the Land Improvement Act rules I think there is no power for Sub-divisional Officers to disburse loans, and under the Agriculturists' Loans Act they have power only on delegation from the Collectors?—Such powers are always delegated. My Sub-divisional Officers have powers under the Land Improvement Act also.

169. *Q.* (*Mr. Rajaratna Mudaliar.*)—Concerning a general cess to be levied on account of irrigation, have you not known a tenant pay more than his share?—Yes. I have not known cases where he pays more than the landlord pays to the Government, but I have known many cases in which he pays the entire cess. He ought to pay half.

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170. *Q.* Have you no power to prevent it?—We are powerless to prevent it. The rayats, as a rule, acquiesce in such action.

171. *Q.* (*Mr. Allen.*)—You spoke of the commutation of *bhaoli* tenure into *nakdi* on a large scale. Would not there be a difficulty in getting the tenants to combine to keep up their *gilandazi*?—If it were done on the lines suggested, there would be no difficulty whatever.

172. *Q.* But the legislation you proposed had reference to *pains* to large works? You would not propose legislation in order to keep up *ahars*?—Yes, certainly I would.

173. *Q.* (*Mr. Muir-Mackenzie.*)—Would you not require a very large inspecting staff?—Not necessarily. Rayats would soon complain if a landlord were not maintaining his *pain*, and proprietors also. It would come to the knowledge of the Collector, and he would know when to depute an officer. It would not require a standing army of inspecting officers.

Mr. J. H. Toogood, Superintending Engineer, Sone Circle.

(*Bankipore, 25th October 1902.*)

Mr. J. H. Toogood.

1. *Q.* (*The President.*)—How long have you been Superintending Engineer of the Sone Circle?—Five years.

2. *Q.* And as I know you have had long experience here before?—Yes, as Assistant Engineer and Executive Engineer.

3. *Q.* We have had ample evidence that the irrigation here is extremely popular, as popular as I have seen anywhere.

4. *Q.* I understand that the whole supply that you can count upon in the *hathia* is employed?—Certainly.

5. *Q.* In every year?—Not every year. In 1899 the supply of water fell below; and if we had had to supply water to a larger area, we should not have been able to do so.

6. *Q.* The *hathia* is a period of about 15 days?—Yes, generally from the 26th of September to the 10th of October.

7. *Q.* Could you in a year, when the supply failed, say to the rayats—"We cannot give it to you in 15 days, but we can give it to you in 22 days"?—That was what practically happened in 1899.

8. *Q.* Were they much worse off?—I don't think they were.

9. *Q.* Did they cry out for remissions? Did you grant them remissions?—No. We gave remissions where the crop fell below a certain average.

10. *Q.* During the whole season there are periods when there is more water than is actually wanted, even the *hathia*?—There are periods in which we have more water than is required.

11. *Q.* Would it be worth while to take measures for increasing the supply of the canals for that time?—I am afraid the expense would be prohibitive.

12. *Q.* I should like to know whether you could cut down the walls of your weirs so as to create greater velocity?—It would cost a certain amount of money, but it might be worth it. It might damage navigation, but that would be immaterial.

13. *Q.* Is it a thing that has come before you?—I have thought of it.

14. *Q.* I understand that the extreme pressure at the time of the *hathia* is due to the draining off of the whole rice-fields just before?—Yes.

15. *Q.* Could you to any advantage arrange to fill *ahars* just before, say in the first week of September?—We could fill the *ahars*, but it would affect the irrigation. I fancy if we went in for that system the leases would decrease. I don't see how you could quite make an assessment.

16. *Q.* (*Mr. Muir-Mackenzie.*)—Is there not enough water to supply the leases and to fill the *ahars* as well?—There would be at times.

17. *Q.* (*The President.*)—Could one use the *ahars* as supplementary storage basins?—Of course where the whole block or all the lands below the *ahars* were under leases there would be no harm in filling the *ahars* when we are spilling water.

18. *Q.* In September you are spilling water?—Generally we are.

19. *Q.* You think the difficulty would be about assessment?—Yes. Some of these *ahars* are connected one with another, and they would probably pass on the water to unleased lands.

20. *Q.* Is there inside the field of irrigation a considerable amount of water supplied to lands which do not pay any canal rates?—There is. We try to prevent the *ahars* being filled from the canals except at certain times when water is given at fixed rates, but there is always a lot of malpractices in the way of water being taken into unleased lands.

21. *Q.* If these malpractices mean wastage of water, they are malpractices. If they mean merely a question of difficulty of assessment, would not you wish to get rid of that difficulty somehow? For instance, could not the difficulty be got over so as to store and utilize water, the *ahars* being used as reservoirs?—If all the lands were leased, of course there would be no objection whatever; but of course there are certain high lands, which could not be irrigated under the *ahars*.

22. *Q.* (*Mr. Rajaratna Mudaliar.*)—Might the *ahars* be filled by arranging for lump payments from the zamindars?—You would have to select your *ahars* for that purpose. You might do it that way. It is possible.

23. *Q.* (*The President.*)—You say the sugar-cane cultivation has been doubled since the construction of the Sone canals. Its area is limited to the hot-weather supply?—Yes.

24. *Q.* You mean the supply before the rains?—Just before the rains. The hot weather season ends with the 25th of June.

25. *Q.* What are you irrigating besides sugar-cane, then?—Sugar-cane is the principal crop; there is a little indigo also.

26. *Q.* Do you practically take every drop of water you can for sugar-cane?—We are often very hard pressed indeed for the sugar-cane. In fact, the eastern main system has often to be closed owing to dearth of water in the hot weather, *i.e.*, from the 20th of April; the water we let out is even sold.

27. *Q.* We found elsewhere a very considerable system of supplementing canal irrigation and tank irrigation by wells?—You see here the staple food of the district is rice, and that cannot be irrigated by wells.

28. *Q.* I mean for crops like sugar-cane?—They do irrigate a little sugar-cane in places from wells; in the Bhabua Sub-division I have seen a large plot of sugar-cane irrigated from a well.

29. *Q.* They would not think of helping canal irrigation by irrigation wells?—I don't think so.

30. What is your hot-weather supply?—It goes down to about 600 or 700 cusecs.

31. *Q.* There has been no question of storage in the valley of the Sone; has there?—No; I don't think there is any project, unless you take those smaller irrigation streams in Chota Nagpur. They are on the tributaries of the Sone.

32. *Q.* I suppose you have not much occasion to go into Bhabua?—I have to visit Bhabua; I mean just going by railway to Bhabua, but I have not travelled about much within the Bhabua Sub-division.

33. *Q.* You were here before the irrigation by the Sone Canals began. Is Bhabua very much in the same state as this part was before it came under irrigation?—I think Bhabua is very much worse than the Shahabad tracts were without canals.

34. *Q.* (*Mr. Muir-Mackenzie.*)—What did these depend on then?—*Ahars* principally.

35. *Q.* Shahabad is very much like Gya?—Totally different. It is a flatter country. Gya is an undulating country. It (Gya) is like parts of Madras.

36. *Q.* (*The President.*)—In the report of the Karamnassa scheme I find in Mr. Maconochy's report that he says:—"The question of command is the next one to be considered, and here we are met by the difficulty that the Karamnassa traverses the western and northern portions of the district concerned, so that the bulk of the storage is unsuitably placed for conveyance to the affected tracts." He also goes on to say:—"The only solution to the difficulty appears to be to construct a high level canal, taking off from a weir, to be constructed as close as practicable to

the point where the Karamnassa emerges from the hills (say, at about the level of the 270′ or 280′ contour) and running nearly due east for about 36 miles, falling gradually to about the 250′ contour at the point where it would meet the Kudra river." Could you not take a canal from the bottom of it?—Those reservoirs are too high up the river for a canal to be taken direct from them. The reservoirs are very high and there is a water-fall of 175 feet below their proposed sites.

37. *Q.* Then the river itself would be made to carry water?—The reservoirs would hold the water and the river would be used to carry it to a weir lower down.

38. *Q.* I suppose you think it would be the right thing to thrash out this Karamnassa project and have it properly surveyed?—Most decidedly.

39. *Q.* Have you means in the way of officers for undertaking it?—I have not. It certainly requires a special man—and a good man.

40. *Q.* Has the Province got the means?—Mr. Horn would be able to state that.

41. (*Mr. Horn.*)—I think we could get it done.

42. *Q.* (*The President.*)—You heard Mr. Rajaratna's examination just now. Can you give us information as to what the cost per acre is for the measurements?—It has all been most carefully worked out in this book. It comes to about 5½ annas per acre. I think the Deputy Collector's establishment costs between Rs. 60,000 and Rs. 70,000 a year. The cost of measurement and collection are nearly equal—between 7 and 8 per cent. each. At present the cost of measurement and collection is nearly half-and-half.

43. *Q.* That is, 15 per cent. both for measurement and collection?—About that.

44. *Q.* Are you satisfied with the way that the contract system works?—I am quite satisfied; it is very good.

45. *Q.* It does not lead to any waste of water; want of economy of water?—It is minimised.

46. *Q.* Do you look after the village channels?—Yes, they are under us. They are paid for by the villagers and zamindars, but they are under our supervision, and we can enforce their repairs under section 60 of the Canals Act.

47. *Q.* Are you satisfied that the period of seven years is a suitable one for leases?—I think it is about the limit it should be.

48. *Q.* You think it should not be longer?—I certainly don't think it should be longer. People die, and you find many changes in seven years.

49. *Q.* Have you any suggestions which you would like to bring before the Commission as regards the points before it?—I don't think so. I don't think there is anything.

50. *Q.* Have you found here any demand for drainage accompanying irrigation?—That was so some years ago, just after the irrigation commenced on the Sone Canals, and a large number of drainages were carried out.

51. *Q.* You have a number of drainage channels?—Yes.

52. *Q.* (*Sir Thomas Higham.*)—As regards these questions of measurement, I understand you have very little measurement to do in the Sone Canals?—A great deal of measurement has to be done. Blocks have to be measured when you give a lease.

53. *Q.* After you have given the lease you don't measure at the end of the cropping to see which parts of the field have taken water and which have not?—No, we assume all has been watered. A man is liable whether he takes or does not take the water.

54. *Q.* What is the use of your measurement staff?—We have to retain a certain number, because in one year a certain number of leases lapse.

55. *Q.* Your measurements are not only on the applications for long leases, but subsequently for the *rabi* and perennial crops?—Yes.

56. *Q.* (*Mr. Muir-Mackenzie.*)—Also for the season leases?—They are generally measured up about the time the applications are made; sometimes before, sometimes after. We try to measure them up before we grant the leases. The *kharif* season leases are in blocks.

57. *Q.* Could you tell us something about these blocks; what are the sizes of these blocks?—They vary very much. We have some 40 *bighas* or 25 acres. That is the smallest block. The rule is nothing less than 50 acres is leased. Some villages have 800 or 900 or 1,000 acres,—perhaps more.

Mr. J. H. Toogood.

58. *Q.* I suppose you never have a block divided between two villages?—Sometimes we add a small area in one village to a larger block in another.

59. *Q.* For convenience?—Yes.

60. *Q.* As a rule, the block is village by village?—Yes.

61. *Q.* But you may have more than one block in a village?—Yes. We have more than one block; sometimes two or three blocks. However, I am trying to get them so that all the leases expire simultaneously.

62. *Q.* Supposing some of the owners in those blocks do not want water, what happens?—If they do not all agree, that is to say, if a very small percentage is left out, we give in and grant lease. But it must be a very small percentage. We generally wait till they all agree.

63. *Q.* If they do not all agree, you do not give a lease?—We do not unless there are a very few left out; and if there are a few, we try and catch them. We keep a watch on those who are left out. They have our special regard.

64. *Q.* That means an establishment?—Yes. Patrols go round to look after them.

65. *Q.* Then what do you do in regard to remissions?—No remissions can be granted on long lease lands, except specially under the Superintending Engineer's orders.

66. *Q.* On what grounds does he grant that?—If the field has been left uncultivated, he might grant it, or if the man has bolted.

67. *Q.* If the water has been available and the man does not take it, do you grant him remission?—Very rarely. I think in the last three years about Rs. 13 has been granted.

68. *Q.* Have you no claims for remission on the ground that the supply was not sufficient or regular enough?—We have had no such complaints.

69. *Q.* You never give remissions on that ground?—No.

70. *Q.* You never have applications for remission on account of irregular supply?—We may have had, but there have been very few complaints.

71. *Q.* Then practically you give no remissions?—None on the long leases.

72. *Q.* (*Mr. Muir-Mackenzie.*)—But you do on the season leases?—Yes, we do on season leases, but not on *kharif* season leases.

73. *Q.* (*Sir Thomas Higham.*)—Season leases are not entitled to water until long leases have had theirs?—Generally we look after the supply to the long leases first.

74. *Q.* A long lease has a preferential claim?—Yes.

75. *Q.* Therefore season leases might have a short supply?—Well, I don't recollect any cases.

76. *Q.* If there was a short supply, would you give remissions?—We don't give remissions generally in block areas, and the season *kharif* leases are block areas.

77. *Q.* In *rabi* you give remissions?—Yes.

78. *Q.* And perennial?—Yes.

79. *Q.* On account of short supply?—It is generally failure of crop.

80. *Q.* From whatever causes?—It is generally not due to our short supply.

81. *Q.* Supposing crops were eaten up by locusts, would you give remissions for that?—We have done so.

82. *Q.* You don't make a regular practice of it?—No.

83. *Q.* What is the system of rotation in giving water?—Is it given continuously to the people?—For ten days they get water consecutively, and then for five days they are shut off, and so on.

84. *Q.* That is the practice?—On the Patna side they have 12 and 4 days respectively. We shall probably reduce that to 10 and 5 days respectively. Ten and five days is the general system.

85. *Q.* (*The President.*)—What percentage of the lands are watered, as a rule?—No. Fifty per cent. is what we limit ourselves to a certain extent, but we do go up to 80 or 90 per cent. in a small village.

86. *Q.* Theoretically, you irrigate about 50 per cent.?—Yes, so as to distribute the benefits of the water more evenly throughout.

87. *Q.* (*Sir Thomas Higham.*)—Then I understand your capacity is limited by what you can do in the first 15 days of October?—Yes, they must have water for the rice crop during that period.

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88. *Q.* Both the late rice and the early rice?—Not the early rice. For the early rice they don't want the water; for the late rice they want it.

89. *Q.* In Maconochy's book he says that the duties are based on the total *kharif* area,—not on the late rice area?—Yes, but the area of early rice is a very small proportion.

90. *Q.* The only time you have really fallen short in the *hathia* was in 1899?—Yes, in October 1899.

91. *Q.* What is the maximum supply of the canals?—4,500 cusecs in the main western system and 1,850 cusecs in the main eastern system.

92. *Q.* What did you do in 1899?—I distributed the supply between the three main branches.

93. *Q.* The three main branches are?—The Patna, Arrah, and Buxar. The water was distributed between them according to area leased.

94. *Q.* Now you are refusing leases on account of the experience of that year?—To a certain extent we are refusing leases on account of the limited capacity of our canals. The capacity of our canals is only 6,350 cusecs.

95. *Q.* In 1899 you say you refused applications for 40,000 acres?—Yes. That is, where it was beyond our *kharif* limit, we could not extend the water there. Our canals only carry 6,350 cusecs.

96. *Q.* That is because you have not got the water?—Yes.

97. *Q.* The irrigation for large areas has naturally to be reduced when there is a want of water?—Yes, and we have not got the water. We cannot carry more than 6,530 cusecs. If you take 6,350 cubic feet and multiply it by 60, that gives about 360,000 acres.

98. *Q.* You can never do more than 360,000 in the *kharif* area?—I don't think so, unless we increase our carrying capacity, and we must also consider the water wanted in the *hathia.*

99. *Q.* You are limited by the water wanted in the *hathia*?—Yes; by the amount of water we can give during the *hathia.*

100. *Q.* What do you call the *hathia*, 15 days in October?—15 days. It is a lunar asterism.

101. *Q.* Cannot it be stretched?—I have already said I think it can. I think in 1899 we practically did stretch it. It is the only year we probably did stretch it, but I think it affected the crop. I told the people distinctly that year when they came and crowded round my compound—"If you use the water carefully, you will get a very fair crop; you will not get a full 16-anna crop, but you will get 14-anna."

102. *Q.* You did not give many remissions?—No. We gave certain remissions, if they had a very bad crop.

103. *Q.* When leases fall, are they invariably renewed, or is there any difficulty in doing so?—The people are always eager to renew them. They never let them drop, not if they can help it. We generally refuse those who will not comply with our conditions of making proper boundaries, improving their village channels, etc.

104. *Q.* Then if you have got so many applications, I suppose you have a strong hand?—Yes, we have. The rayats are very loth to lose a lease.

105. *Q.* The area that lapsed this year was 36,000?—Yes, and the total area applied for was 141,000.

106. *Q.* Have you a perfectly free hand in refusing or renewing a lease?—Yes.

107. *Q.* If a man has had a lease for seven years, could you say—"we won't give it to you"?—If he does not comply with our conditions. Now water is so valuable here, people are eager to get it; and if they don't comply with the conditions, we do refuse them.

108. *Q.* But if they comply with the conditions, you don't refuse?—We never refuse.

109. *Q.* Have they any rights?—I don't think so.

110. *Q.* You do refuse them now and again?—Yes, we have refused them.

111. *Q.* When were the rates last revised?—The former rates expired in 1895-96 and were then revised.

112. *Q.* Were they raised then?—Yes.

113. *Q.* Is there any legal objection to their being raised at any time? None whatever.

114. *Q.* Then it is a matter of supply and demand?—Just so. It is a matter of supply and demand; and also the benefits that the cultivators get from irrigation; I mean the extra produce they get.

115. *Q.* Supposing you said that, instead of charging Rs. 2-8 for the long system leases, you would charge Rs. 3, there is nothing to prevent your doing that?—No. I think there is every reason for us to do so.

116. *Q.* It is now seven years since the rates were last revised?—To when does the present rate extend?—Up to March 1904.

117. *Q.* Is there any question of raising them then?—It is now under consideration.

118. *Q.* (*Mr. Muir-Mackenzie.*)—You cannot raise the rates in the middle of the lease?—No.

119. *Q.* (*Sir Thomas Higham.*)—How far does Government deliver water? Does it deliver it into each block?—Government delivers water up to each block. We are trying to get the channels extended well into the blocks.

120. *Q.* The Government channels?—We have no Government channels; they are all private channels.

121. *Q.* You have distributaries?—Yes, and they are Government channels.

122. *Q.* Do these distributaries go into the villages?—No.

123. *Q.* Is water brought into the edge of every village?—No.

124. *Q.* And the village channels may have to pass through another village?—Very often, and we have to acquire the land for these channels. Generally the people give the lands where the channel is in their own village. They can arrange this among themselves; if not, we acquire the land under the Act.

125. *Q.* Do you pay for the land?—Yes. The applicant for the village channel has to deposit the money in the Executive Engineer's office before any preliminary action is taken.

126. *Q.* Do you buy the land?—Yes. We take up the land under the Land Acquisition Act.

127. *Q.* Is there any objection?—Yes, they always want the channel to go another way. They always want to save their own lands and put it in their neighbours'.

128. *Q.* What is the length of these water-courses?—We limit them to 2 miles.

129. *Q.* What do you mean?—We don't allow them to go more than 2 miles from the distributaries.

130. *Q.* If they want to go further, do you make another distributary?—As we have not got the water, I throw out those applications, because lots of our distributaries run dry during the *kharif* season.

131. *Q.* Does much waste go on in these water-courses?—There is not much waste, but there is a certain amount of waste, because some of the older channels are not in excellent order, and then, again, every year channels are damaged, because each man gives the channel a cut with his *kodali* and gradually the channels get into bad order, so that it is necessary after the seven years to be more particular that the channels should be brought into repair.

132. *Q.* Before you renew your leases you can insist on the repairs?—Yes, that is one of the points that I insist upon. I am very particular about that.

133. *Q.* (*Mr. Muir-Mackenzie.*)—With the irrigation so popular and the demand for water so keen, why is it that the anticipations as to the revenue likely to be realised on the Sone Canals have been disappointing? Is it because the canal has not carried as much water as you expected? Well, first of all, the duty is much smaller than was expected, and then, again, the navigation has not come up to anticipations. Another reason is that the anticipations were made upon the large *rabi* cultivation which has not occurred.

134. *Q.* You don't think you could increase the *rabi* cultivation by lowering the rates temporarily?—I would raise the *rabi* rates, because what has happened is exclusion of the *rabi* lands within the long leased blocks. They have all, as far as possible, been converted into rice lands, and there is no *rabi* exclusively sown on them.

135 *Q.* Still I don't understand why you would raise the *rabi* rates?—There is generally enough moisture in these

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lands in ordinary years, so they are not leased except in bad years.

136. *Q.* You don't think, if you lowered the *rabi* rates, they would be inclined to take water?—I doubt whether the leased area of *rabi* would increase.

137. *Q.* Do you find that the value of land has increased very much?—From all I hear, rents have very considerably increased.

138. *Q.* You know instances where rentals have considerably increased?—There is a very interesting paper on that subject by Mr. Luson. I have it here.

139. *Q.* At any rate it is your belief that the value of land has very largely increased. Rentals have also increased; have they not?—Yes.

140. *Q.* Even where the system of rentals is cash?—Yes, even in the cash rentals.

141. *Q.* Do you know how the landlord manages that in spite of the Tenancy Act?—I have heard landlords express the view that they can drive a carriage and pair through the Tenancy Act.

142. *Q.* (*Mr. Rajaratna Mudaliar.*)—Even in the case of occupancy tenants?—I believe so.

143. *Q.* (*Mr. Muir-Mackenzie.*)—The tenants find it best to keep on good terms with their landlords?—Yes. There is a sort of mutual self-help society between the landlords and tenants. There is no doubt landlords do a great deal of good in times when the rayats are in want.

144. *Q.* You don't think that when the landlords' shares have been increased in value that it would be advisable to take an owner's rate from the landlords?—There would be very great objections to it on the part of the landlords. That ought to have been done in the first instance. I don't think it would be advisable to attempt it now.

145. *Q.* Because of the objections that would be raised?—Yes, although it would be quite justifiable to do so.

146. *Q.* (*Mr. Rajaratna Mudaliar.*)—You said that Shahabad was chiefly dependent on *ahars* before the canal was constructed?—Yes.

147. *Q.* Did the construction of the canal interfere with the old sources of irrigation?—No. They got the same drainage water into them as before, except, perhaps, from that little strip occupied by the canal.

148. *Q.* Are there no cases in which the canal interfered?—There may be one or two cases; I don't recollect any. I daresay there might have been where the canal took up an *ahar* itself. I think you will see that in Mr. Luson's note also.

149. *Q.* (*The President.*)—A note prepared for the Government?—Yes.

150. *Q.* (*Mr. Rajaratna Mudaliar.*)—In such cases you supplied the water displaced by the canal?—I think in most of them. The lands alongside the canal are nearly all leased.

151. *Q.* Where the old sources were interfered with, what do you do to compensate the zamindar? Do you supply water to the old irrigated lands?—Of course we do. As I say we are supplying it to those villages alongside the canal which we interfered with.

152. *Q.* You supply water free to such lands?—Certainly not free.

153. *Q.* I find from some papers that water is supplied free from the Madhuban Canal?—Yes. That was constructed by a zamindar, and then afterwards bought.

154. *Q.* Is that in your jurisdiction?—It used to be.

155. *Q.* Why is water supplied free there?—You had better read the papers in the case; it is not in my jurisdiction now.

156. *Q.* Do you see any objection to the work of measurement and collection being done by one and the same staff?—I think one is a check upon the other. It would be most undesirable to have both done by the same staff. It is now done independently by the two parties, and one is a check upon the other.

157. *Q.* Could any saving be effected if the work were done by one and the same staff?—It could be done, but there will be no saving of staff. At present you might say the one is a sort of check upon the other. If the same man measures and makes out bills, the whole thing is in his hands and there can be no check over him.

158. *Q.* (*Mr. Muir-Mackenzie.*)—I want to ask you once again about the *rabi* area. Would not the cultivator, who now hesitates to take water, readily take it if the water-rates were lowered, say, in a season of good rainfall?—I do not think it would be a good thing to have a varying rate for the good and bad seasons. I think the rates are quite low enough now. I have recommended an increase of the rates.

159. *Q.* What is it here?—Here the rate is Rs. 2 an acre for *rabi*.

160. *Q.* I understand that the number of applications complied with is limited to the amount of water supplied during the *hathia*?—Yes.

161. *Q.* Do you think it would not pay better to risk the supply running short in the *hathia* and grant remissions for failure of crop or for injury done, and to comply with the larger number of applications?—There would be enormous difficulty.

162. *Q.* This rarely happens?—I do not say it rarely happens. It happened in 1899, and though I do not say it will happen in this year, it may. The river is beginning to fall now.

163. *Q.* (*The President.*)—You have passed the *hathia*; have you not?—Yes.

164. *Q.* (*Mr. Muir-Mackenzie.*)—Then in 1899 you have told us that the cultivators did contrive to husband the water, and saved a good deal of their crop; they got their 14-anna and did not apply for remission?—Yes.

165. *Q.* Even if you had granted a few more applications, it would have been consistent with giving a full supply through the *hathia*?—Yes, but the people would not welcome that system. A rayat would rather have his crop than his remission.

166. *Q.* You do not think it would be worth while to run a certain risk?—No, I do not think so. We might get up to 350,000 or 400,000, but I doubt if we will go beyond that.

167. *Q.* (*The President.*)—Can you give me any idea how much the capital account of the canals has increased by the splendid provision made for navigation?—I suppose about 50 lakhs on about 275 lakhs.

168. *Q.* That is about 20 per cent.?—Yes. The navigation works were very expensive, and their maintenance is very expensive now.

169. *Q.* Did the navigation ever fulfil at all what was hoped it would before the railway came into these parts?—Never before the railway. During the railway construction we got up to the amount stated by Colonel Dickens by carrying their materials. We never had a large amount of traffic except when the railway was being made.

170. *Q.* Is it appreciated as a boon?—I think the people appreciate the steamer service on the canals. It is still going on.

171. *Q.* Was it at all in the district appreciated as a thing worth making a sacrifice for?—I think so. The steamers appear to run full. The gentleman who has bought the steamers and has hired them is reported to be a wealthy man.

172. *Q.* Has it done much good in the country as regards country-boats?—I think it has done some good, but it has often to be sacrificed to the interest of irrigation. There is sometimes not enough water for both.

173. *Q.* It is killed now?—Well, I am told that the steamer traffic is killing the boats altogether, because the firm have reduced their rates.

174. *Q.* I did not know there were any steamers on the canals?—Two steamers.

175. *Q.* Don't they cut up the banks?—I don't think so.

Mr. E. F. Growse, Officiating Additional Commissioner of Patna, late Collector of Saran.

Mr. E. F. Growse.

(*Muzaffarpur, 27th October 1902.*)

1. *Q.* (*The President.*)—How long have you been in this part of the country?—Two years and four months. As Collector of Saran, until July 1st of the current year.

2. *Q.* Have you had previous experience of this part?—Not of North Bihar.

3. *Q.* I see that the whole district is shown as liable to famine?—That is in the "famine programme" submitted to Government, but I would modify that by saying that the whole district is liable to scarcity and distress, and that some parts of it are liable to severe scarcity and famine.

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It is difficult to define which parts. The phrase quoted is an over-statement.

4. *Q.* What do you consider the best measure to take for this district to minimize famine?—The best, I can think of, is to improve the existing system of the Saran Canals, by which we can get a larger supply of water down the canals, and, when we have got it, to regulate it.

5. *Q.* These Saran Canals are closed altogether now?—Practically. They were opened this year during the last cold weather after pressure had been put on by the local authorities.

6. *Q.* What irrigation are they calculated to do?—They are said to be able to do about 64,000 acres, but the most ever done was in the year 1884-85, when they did about 21,000 acres. Perhaps they could do about 6,000 or 7,000 more. The difficulty was with the working of the canals. That water was not received when it was wanted. It was the complaint of the local planters. The canals were constructed after the famine of 1873-74, and they were opened on a guarantee given by certain indigo-planters. Money was received from Government direct and from the planters, and they recovered from the rayats who used the water, and they also used the water for filling their tanks, etc. But it was an unsatisfactory arrangement to every body.

7. *Q.* The theoretical *maximum* might run up to 64,000 acres?—That has been stated. We have 72,586 acres irrigated from private irrigation works and 121,000 acres of well-irrigation. The former figure is taken from the survey, but the latter is made by merely multiplying the number of wells by a certain figure, and I doubt if it be correct. They have multiplied by four. There are 27,000 odd masonry wells and 3,000 odd *kachcha* wells.

8. *Q.* That is not an extravagant calculation for the acreage of wells?—I doubt whether they do quite so much. I think three acres each would be a fair estimate.

9. *Q.* How do you recommend that the Saran Canals should be administered in the future? Should Government take it over at once as an Imperial work?—No; it is far too small a thing. It would be better if it could be improved and afterwards handed over to the District Board to work. I do not imagine the water would be taken every day for irrigation. Saran is a big wedge between the Gogra and the Gandak, and the Saran embankment runs along the south or right bank of the Gandak and was constructed a good deal more than a hundred years ago and was taken over by the Government at the end of the eighteenth century. It was constructed to protect the whole district from flood; in so doing it closes the mouths of the spill channels which come across the district from the north-west to the south-east. They take their rise in the Gandak mostly. By closing these spill channels, naturally the water received by these channels, which are small rivers, has been very much reduced; and whereas there was deep water in most of them and navigation, practically no boats can go along them now. In many years we do not want irrigation from these rivers; but when we have a year of drought, every drop of water in the district is utilised, and the cultivators are very clever in utilising water in every possible way; and now that the channels which form the so-called canals are closed, it looks like a sin that the water cannot be got down when we want it.

10. *Q.* How do you get the water from the rivers on to the land?—By lift; there is no flow.

11. *Q.* If these canals were improved, they might be really a source of value to the district?—Distinctly.

12. *Q.* What do you propose? That a Government officer, an engineer, should be sent to thresh out what can be done, and to prepare a scheme which Government should carry out and make over to the District Board?—Another idea has been suggested that the District Board should be given the power to construct the works.

13. *Q.* With what money?—Borrowed from Government. But I am not personally in favour of that.

14. *Q.* I suppose it is possible that if it were done, the works might be on a larger scale and more irrigation done?—Yes. But we should not want much larger irrigation except in a few years. Another benefit, which would arise, would be the raising the level of the water in the wells all along this tract. It is a known fact that when the canals were opened regularly, even with the flow of water that they then gave, the well level was raised four or five feet in neighbourhood, and that is a very great consideration. Secondly, there is the sanitary consideration. At present these channels run quite dry after the rains, and they become merely a series of malarious pools, and if we can hold the water up by small weirs in places, we can benefit the district from a sanitary point of view. The banks are notoriously unhealthy. The river Jharahi should also form part of the scheme.

15. *Q.* At present there are really four schemes independent of each other?—It is one scheme. They all come from one river.

16. *Q.* But the making of one does not imply the making of another. They each stand on their own basis?—Yes, but with all four it would be very much better.

17. *Q.* Why were they closed?—Because of the difficulty of finding money to keep them open. Government insisted that before they were opened a certain guarantee should be given and subsequently certain other rules were devised by which an individual wishing to have them open must put down a certain sum of money. No one will come forward and do that now. The indigo industry is not flourishing now, and the only people with enterprise are the planters; the zamindars would not combine for that. The Hutwa Raj which owns most of the northern part would, but they would work it entirely for their own benefit; it would not be a public thing. The cost of constructing and maintaining these canals has fallen and will fall on Government, and naturally Government requires to secure this money, and thus the question of recouping this money arises at once.

18. *Q.* Would the cultivators of that tract be willing to accept a cess?—Not the cultivators; they would pay, probably, if it were ordered, but I would propose a cess on the zamindars.

19. *Q.* Would they not object?—If it were not a very large one, there would be no great opposition, especially if they were to recover half of it from the rayat as with the road cess. Or, looking at it as part of one scheme with the embankment, on the ground that but for the embankment the canals would not be necessary, and thus regarding the embankment and canals as one protective system, there might be one cess. That is to say, that a small water cess might be added to embankment cess and levied on each estate in the district, whether actually protected or not by the canals. The cess has already been levied in this form by contract since 1881 when Sir Antony MacDonnell was Collector of Saran. It is about Rs. 23,600 a year only on the whole district.

20. *Q.* To carry this out it would be, I suppose, a case of a tolerably severe cess until the work was done, and then a light cess for maintenance afterwards; or are you prepared to borrow money from the Government to spread it over more years? Cannot Government be content with interest?—We could have a cess to cover Government interest and cost of maintenance perhaps.

21. *Q.* You think they would take the water every year?—Not all. In some parts, as in the Hutwa Raj, they would take it for their rice nearly every year.

22. *Q.* In what part of the district is there most well irrigation?—Pretty well all through the district.

23. *Q.* The district is not given up body and soul to rice?—No; the rice is about 25 per cent. only. The most important crop is the *rabi*.

24. *Q.* Are the wells on the increase in number?—I should say they were.

25. *Q.* Have you been asked for *takavi* advances?—Not since I have been Collector. The Opium Department have done a good deal in that way. The Hutwa Raj has done something and will probably do a great deal more. Every year it gives advances for the purpose.

26. *Q.* Have you had any forecast made of what it would cost to put these channels in order?—No. I do not look upon this at all as a productive work, but merely as a protective work against certain bad years; and over a period of 30 years there have been four years in which we have had to spend money in relief somewhere in the district in some form or other.

27. *Q.* Have you any land in your district, like the right bank of the Gandak, where the people object to irrigation, saying that it deteriorates the land?—No. There is a general idea or saying—"once irrigate, always irrigate," but they use well water all over the district.

28. *Q.* There are a number of dug tanks, apparently, in Saran?—Yes.

29. *Q.* Do they make any appreciable effect on the irrigation?—They are not of much value; they are so small. They irrigate wheat, barley, and sugar-cane considerably, and all market garden produce and opium.

30. *Q.* Would you advocate the encouragement of wells?—Yes.

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31. *Q.* Is opium extensively cultivated?—Yes.

32. *Q.* (*Sir Thomas Higham.*)—I understand that when these channels were first opened they were handed over to the planters. Were the planters responsible for their maintenance?—No. They took the water, distributed it and paid for it.

33. *Q.* Why was not that arrangement satisfactory?—I would rather other witnesses answered that question. I was not here at the time. There is a certain expense every year for cross *bunds*, etc. They used to say that the maintenance, including establishment, cost Rs. 30,000 a year; and the last few years it has cost about Rs. 6,000, I think. No one personally will come and put down Rs. 6,000. That is why they were closed.

34. *Q.* You cannot put on the cess with the law as it stands; can you?—Yes, if the zamindars would agree to add it to the embankment cess, and I do not see there would be much difficulty about that. The only practical difficulty is this that the embankment cess contract has now 18½ years to run, because we have just started a new contract for twenty years.

35. *Q.* What is the contract?—An estimate is made of what it will cost the Public Works Department to maintain this embankment during 20 years. That is divided by 20 and the sum annually recovered from the zamindars.

36. *Q.* Is the number of wells increasing every year?—I think so.

37. *Q.* Do you make advances for them?—No; a few advances may have been given in 1896-97 by the Collector; but advances are continually given for this purpose by the Opium Department and the Hutwa Raj.

38. *Q.* Only for the cultivation of poppy?—Yes, in the case of the former, but not in the case of the latter.

39. *Q.* If you had weirs, would you charge for each watering?—No; it would all be covered by the cess.

40. *Q.* So some people would get the benefit of the weirs and others would pay for them. These weirs confer a special benefit on a certain number of proprietors near them; but to secure them, the only possible way is to put a cess over the whole district?—There is another method to estimate the area protected and have the cess realised from that area. That would be more equitable, but difficult.

41. *Q.* (*Mr. Muir-Mackenzie.*)—Do you consider the district is likely to be exposed in any year to very acute famine? I see the numbers in the 1874 famine were exceedingly large. Do you consider the 1896-97 famine was absolutely as severe in failure of rains and crops?—We should probably never be likely to get anything more severe than the 1896-97 famine under similar conditions.

42. *Q.* What will be the total area which this system of canals would irrigate; 20,000 acres?—A great deal more than that. It might be a hundred thousand, but perhaps not.

43. *Q.* That is in addition to the 72,000 already?—That is private canals; I don't know what those figures mean, but believe they refer to existing drainage channels improved by certain landed proprietors such as the Hutwa Raj, and some indigo factories, for irrigation; but these are largely dependent on water remaining in the canals or channels which are now closed.

44. *Q.* Are there any instances of extensive areas being irrigated by wells?—Not in Saran.

45. *Q.* What is the crop; highly intensive cultivation highly manured?—Generally in the neighbourhood of villages.

46. *Q.* Do they ever irrigate wheat?—Yes; but not in a year of good moisture.

47. *Q.* Are the wells worked with bullocks or lever?—Both; the lever mostly.

48. *Q.* According to the figures here the area under irrigation is about a half the sown area?—It must be more.

49. *Q.* Would a third be protected in a bad year?—That would not include the Dearas irrigated by the spill from the river. Last year, when there was considerable want of moisture, the rayats were making *kachcha* wells very considerably.

50. *Q.* Do you think a large extension of wells is possible in the district? Would there be difficulty in finding manure or money to make the wells? Could they be doubled?—I daresay.

51. *Q.* Are you satisfied with the machinery at your command for giving advances?—Yes.

52. *Q.* Is there any difficulty in giving advances owing to the cultivators having to come in to head-quarters?—That we could meet ourselves in utilising the planters; and although this is not provided for in the rules, I believe money was so advanced under the Agriculturists' Loans Act through the medium of selected planters in 1897; and I may add that in the same year in Cuttack (Orissa) I sent money out to the rayats in their villages by a Deputy Collector.

53. *Q.* How would you advance through the planters?—Make inquiries first as to who wanted them, and then entrust the money to the planters and also by getting the selected planters to make the necessary preliminary inquiries.

54. *Q.* (*The President.*)—Mr. Tytler in his paper says he advanced Rs. 1,86,000 to build wells, and he was able to do this largely by his own personal influence, having devoted his whole time and energies to this particular work. Do you think it would be an advantage to have, at any rate for a time, a special officer to push it in that way?—Yes, if the need is distinct.

55. *Q.* Are you not satisfied that the need is distinct?—I should like to see first the rivers properly utilized. That would protect a very large portion of the district.

56. *Q.* Mr. Tytler says it would be possible to have a well in every 10 or 15 acres of the district?—In some parts.

57. *Q.* Is there no danger of exhausting the water in the sub-soil?—Not, if we have water coming down from the rivers.

58. *Q.* (*Mr. Rajaratna Mudaliar.*)—Could not the proprietors pay the cost of keeping open these channels and recover from the tenants?—It would require legislation.

59. *Q.* They can levy enhanced rents?—It is only required for protection; not every year; it is not with a view to increase produce. Nor could they enhance the rents legally.

60. *Q.* You say the construction of the embankment has deprived a large area of the benefit of spill irrigation; what area was affected?—The whole district.

61. *Q.* Has cultivation suffered in consequence?—That is going back to over a hundred years. Conditions must be changed. It must have been an improvement generally, but undoubtedly individual portions have been injured.

62. *Q.* Do you think proprietors can be trusted to disburse loans to tenants?—Very few. I doubt whether they would undertake to do it. They would be afraid to deal with Government money, and I do not think it would be very safe to give it to them.

63. *Q.* Is the whole of the embankment cess spent?—I believe the last contract was an actual loss.

64. *Q.* (*Mr. Muir-Mackenzie.*)—Mr. Tytler got the smaller cultivators to combine to receive the advances. Is that practicable?—Mr. Tytler was an unusual person. He had been 26 years in the district and knew pretty well every cultivator personally in the north-western half of the district.

Mr. R. S. King.

Mr. R. S. King, Manager, Darbhanga Raj.

(*Darbhanga, 30th October 1903.*)

1. *Q.* (*The President.*)—You are one of the managers of this Raj?—I am sub-manager of this Raj.

2. *Q.* How long have you been in it?—Thirteen years.

3. *Q.* You have a very intimate acquaintance with the people here and have seen them through these years of famine?—Yes.

Mr. R. S. King.

4. *Q.* You have managed to frame some relief works?—Yes.

5. *Q.* We have read with great interest what you have done on the Kamla. Have you a map here?—There is a map here which I think would give it at a glance. This is it (hands it in). It is on an inch to the mile scale, and as regards the different Sections A, B and C, A is the portion in which the crops have been secured during the last season, B represents the portion in which the *rabi* crop was irrigated and C are the villages which the water reached in February, March and April for filling the tanks. watering the cattle and giving water to seedlings for the current year. (Explained on map.) This *bund* (indicates Narkattia) was begun in November and was finished on the 12th of December. It burst three times before it was finally finished. The *bund* cost about Rs. 1,000 for making and maintaining for six months. There were continual freshets coming down the river, and I ran the water into the old beds of the Kamla and irrigated all these crops (shown on map). It was not raised high enough to take it down this channel (indicates) until we made an embankment.

6. *Q.* Is this (points to it) all rice land?—Roughly $\frac{2}{3}$ of it is.

7. *Q.* Did they get their *hathia* water?—No; with irrigation water this crop was pulled through; on an average they got 12 or 14 annas of it.

8. *Q.* You can claim all this yellow (on map) as crops secured and all this green (on map) as crops saved by your *bunds* or channels?—Yes. It was not in time for the sowing of the *rabi*. The *rabi* which was sown was secured, but it was not a full *rabi* crop. The *rabi* was sown in October and the water began to come down here in December. The water was running down this Arerh channel. The *bhadoi* and rice and *rabi* were all secured.

9. *Q.* Suppose none of these channels were made, would all these crops have been lost?—No, I don't think so. In parts you would have got half; on the west you would have had a four-anna or six-anna crop, I think. There would have been scarcity, but I don't think there would have been famine exactly.

10. *Q.* How many *bighas* or acres do you consider that you irrigated by these means?—It is shown in brief here (map) 40,000 acres of yellow; that is the crop secured. 5,000 *rabi* irrigated after it had been sown and 15,000 *bighas* of these villages (shown on map) which had water given to them in their tanks for their cattle and for their seedlings.

11. *Q.* Then 45,000 *bighas* were really irrigated?—Yes. (At this stage Mr. Maddox put in some statistics showing that the outturn of crops on Mr. King's channels was 85 per cent. of the normal, while that on the west of this irrigated area averaged 31 per cent., on the east 22 per cent., and on the south 19 per cent.)

12. *Q.* So this irrigation quite doubled the value of the outturn?—More than that. It would be multiplied by four.

13. *Q.* And the outlay altogether was how much?—Including the channel made in 1897 it was between Rs. 13,000 and Rs. 14,000.

14. *Q.* Did you first make these channels in 1897?—I made this channel (indicates on map Narkattia) in 1897 and also this one here (indicates on map Arerh). I spent Rs. 10,000 in 1897 and Rs. 4,000 last year.

15. *Q* It was a very successful enterprise, I think?—It was only done bit by bit from practical experience of how the water had been flowing for years with the help of the natives.

16. *Q.* Now how often did the people want water between 1897—1900? Did you use the channels at all in 1898 and in 1901?—No. They did not require water then, though, as a matter of fact, this Narkattia channel remained open, because the *maliks* would not allow it to be closed at the top, but it did irrigate with benefit and gave fuller crops.

17. *Q.* Why would you have closed it?—I would have closed it because I did not think there was any necessity for it, and it would have prevented it from silting. I thought it was needless to keep it open. I did make a *bund*, but the *maliks* would not allow it to be closed.

18. *Q.* Then the *bund* was not within the Maharaja's dominion?—No. It belongs to a petty *malik*.

19. *Q.* Now what would you like to do to ensure and improve this irrigation which you have started there? Would you like to put a permanent weir across the Kamla at that place?—I should be afraid of the Kamla leaving the weir.

20. *Q.* Where is the place where the Kamla Canal is expected to come out?—Near Jainagar further up here (indicates on the map). About a mile from the frontier, I think. I am not quite certain.

21. *Q.* In fact the Kamla irrigation would not be in your tract at all? It would be away to the east?—Yes.

22. *Q.* If that canal were made, your area would be cut off from irrigation. In a year of drought your supply would be completely cut off?—Yes. It would be merely transferring irrigation from one place to another. Last year in April the water was not sufficient in the Kamla river to fill my channels fully.

23. *Q.* In April do you want water for your *rabi*?—If the water was given in October, it would not be wanted in April. In fact the *rabi* in this part of the country does not require any water if there is a full rainfall at the end of the year in October.

24. *Q.* If the Kamla scheme is carried out, it means crippling your work?—I think, if this Kamla scheme were carried out, the crops protected by it would be secured long before the river would dry up. There would be ample water for everything in October. They would not require water in February and March at all if the crops were secured in October, and there is always ample water then.

25. *Q.* The Kamla project is for 600 cubic feet a second?—I don't remember.

26. *Q.* That would not be enough for all the lands to be irrigated?—The waste water in October would do for me. I do not apprehend that the Kamla scheme will take away my water. The crops could be secured by good water before October.

27. *Q.* What about a dry year?—There are freshets coming down when there is no local rain, and I believe there would be ample water for giving all this here (map) a good crop of rice and the waste water would be sufficient for these channels.

28. *Q.* (*Sir Thomas Higham.*)—You would be able to make your *bund* so much earlier?—Yes.

29. *Q.* (*The President.*)—I am chiefly thinking of a year of drought?—The river generally rises sufficiently in the previous rains to give ample water for securing these crops before the end of October.

30. *Q.* October is the crucial month; is it not?—Yes. If we get good water in October, it will secure all the rice which has been planted. In years of the greatest drought such as 1897 and 1902 from $\frac{1}{3}$ to $\frac{1}{2}$ of the rice area has remained unplanted owing to insufficient rain in August and September. That is plenty and gives moisture for the *rabi*. They don't want water after the *rabi* is sown.

31. *Q.* I must say I cannot see how in a year like 1901-02 you could irrigate, say, 40,000 *bighas*, and yet have this Kamla scheme in full swing?—The volume of water that comes down the Kamla up till the end of October is sufficient for irrigating the whole district.

32. *Q.* Our evidence is that the supply is only 600 cubic feet a second. We are told that 600 cubic feet a second is all that we can count upon in October. Forty thousand *bighas* will use up all that?—At the end of October the minimum would be 600 cubic feet and this work may be done before the 15th of October. I think the evidence shows that the river falls very suddenly.

33. *Q.* A year of extreme drought is what I am thinking of?—I have got a record of the rainfall here for 25 years, and in all the years the river has been full. Freshets have been coming down constantly every fortnight or so up to middle of October, setting these channels going fully and giving full irrigation.

34. *Q.* You have done so much at so little cost here that I am doubtful whether it is worth while spending ten lakhs on the Kamla scheme?—My scheme is only for one local area. I think a system of *pains* (*i.e.*, channels) north and south would be very useful.

35. *Q.* You know all about the Dhaus scheme?—Yes, I have read about it. I have known the Dhaus for 16 years.

36. *Q.* Considering the hold that the Nepal people have on the upper water of that river, is it in your opinion worth spending much money upon it?—I don't think so.

37. *Q.* Would you reject it altogether?—I am not qualified to say that. The river has been bunded not only in Nepal, but also on this side of the frontier in British India. It has been bunded off and on for the last 15 or 16 years. I only say that I do not think it is worth spending much money upon, because the water-supply from that river is

not much, otherwise they would not have been able to bund it.

38. *Q.* (*Sir Thomas Higham.*)—In making this *bund* on the Kamla I suppose you employed famine labour?—I had about 500 men working on it.

39. *Q.* Where did you get them from?—Locally.

40. *Q.* Did all the villages interested in it send up men to help?—Yes, but the volunteers were of very little use. They generally arrived about 12 or 1 o'clock and went away at 4, and they asked for some food to eat in the middle of the day.

41. *Q.* What did you do?—I had to do it by contract work, except of course what was done departmentally.

42. *Q.* What was done departmentally?—What they call locally *goors*, made with bales of grass and clay wrapped together—the only thing that could be used for a *bund*. In this sandy river all that was done departmentally by daily labour we could not do it by contract work, because we could not get anyone to take it up.

43. *Q.* You did not get anything like a levy from your villages?—No; we had no *corvée*. We simply asked for volunteers who did very little but look on. If I had depended on the volunteers, the *bund* instead of bursting three times would have burst a dozen times or more.

44. *Q.* For how many years have you made this *bund*?—The *bund* was made for the first time in 1897 and it was made again last year, 1901.

45. *Q.* You have not made it every year?—No; it is not required.

46. *Q.* You have only done it twice?—Yes. Before 1897 the natives said this river could not be bunded, or at any rate they had not succeeded in doing it.

47. *Q.* Which was the easiest, in 1897 or 1901?—In 1901, I think. I had the experience of 1897 then to help me.

48. *Q.* This *bund* took you four or five weeks?—Yes. It was about 550 feet or 600 feet long.

49. *Q.* Do you know anything about the floods? Do they have very big floods in the Kamla?—Yes. It is impossible to understand what floods these are without seeing them. The whole country is simply one sheet of water.

50. *Q.* Is there any spill above in Nepal?—I suppose it does flood there equally, but I have not been up to see.

51. *Q.* Any canal that came up here (indicates on the map) would be liable to be swept away?—Of course this year it was an abnormally destructive flood, but I have not got enough professional knowledge to say that.

52. *Q.* You say the whole country is flooded?—Yes, to my knowledge it spills from the frontier down to Mohanpur Ghât.

53. *Q.* As far as Nepal is concerned something might be done here to shut off the spills?—We cannot shut off any spill in Nepal whatever we do here. I am not aware what the depth of the spill is here. Jainagar is on high land, and I think the spill is chiefly to the west of it.

54. *Q.* What happens when a big flood comes down?—This channel (indicates on the map) I had protected with a very high bank at the mouth with spurs after the drought, so that the flood did not pass down it save what flowed in from the sides when the country flooded.

55. *Q.* All the schemes that have been put before us are all worked out on the supposition that as a *sine quâ non* water would be given to the rice in the first 15 days of October, what they call the *hathia*?—Yes.

56. *Q.* What do you call the *hathia* here?—It varies in the different years. Generally it is the first fortnight in October.

57. *Q.* During that part of the time you have got freshets and part of the time you have got no water?—Yes.

58. *Q.* In 1901, if you had no freshets during that particular fortnight, what would have happened?—It would have been probably an 8-anna crop instead of 14-anna crop.

59. *Q.* I suppose it had got water before the *hathia*?—Ample water.

60. *Q.* If, instead of water being given to the rice crop in the *hathia*, it is given up to the 15th of November?—I should say it would secure it from drying up and being a failure. It need not be given in the first fortnight of October. It may be given up to the first week in November. It would then save the crops. I know that from my experience of 1897.

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61. *Q.* (*The President.*)—Do the people here consider it necessary to run the water off their fields in September?—When they have a normal rainy season they begin running off the water in September; they do not do so in dry years.

62. *Q.* We were told that on the Sone Canals they looked upon it as essential to run off the whole of the water in September, and that then they must have this *hathia* water at the beginning of October?—I think that if they could depend on getting a supply in the *hathia*, they would run it off a great deal more than they do.

63. *Q.* (*Mr. Muir-Mackenzie.*)—According to Mr. Maddox, in order to get a real famine in the district, it requires two successive years of failure. Would you say that?—Yes. Well, I should modify that, because we had not two years of failure in 1897; then there was only one year of real failure.

64. *Q.* Mr. Maddox in his paper points out that the rice crop in 1896-97 was worth only 31 per cent. and only 69 per cent. in the year before. The necessity for the large relief measures was occasioned by their having had a short crop a year before?—I should think it was very much accentuated by their having a poor crop the year before; but we would have required measures of relief probably for $\frac{1}{2}$ or $\frac{2}{3}$ of the actual area even if there had been a full crop the year previous.

65. *Q.* With regard to these channels that you have made, how do you hope to get them maintained?—I have not made any arrangement for that. I asked the rayats who had got full crops to give me half an anna per *bigha* for the maintenance of the channels, and they have done so after a good deal of delay, and I hold some of the money in hand now for clearing the silt from the channels. Altogether Rs. 1,900 was paid for the purpose.

66. *Q.* You have no power of calling on them for labour?—No.

67. *Q.* It depended entirely on their being willing to give the money?—Yes, it was quite optional. The money was only towards the maintenance of the channels, and I proposed it only as a tentative measure. I had enough trouble in doing it, and I do not feel inclined to do it again. There was too much trouble about it for the return.

68. *Q.* Are they not enough alive to their own interests to help you as regards this?—Once they have secured a good crop they do not care a bit, though while they want water they promise you anything.

69. *Q.* You said you were able to carry this scheme of yours through from your intimate knowledge of the country. Do you think you might find a good many other places where the same thing might be done if you had time for examining the country?—It would only be after living in the country for some years and going round it that you could do anything. I don't think it would be possible by a simple examination.

70. *Q.* I mean by a professional man?—A person knowing the levels and who had a contour map might do a great deal in this way.

71. *Q.* Was there much *bhadoi* rice in that irrigated area?—No.

72. *Q.* It was always an *aghani* area?—Yes.

73. *Q.* Can you tell me from your knowledge of the country whether the increase of means of irrigation is likely to result in the substitution of *aghani* for *bhadoi*?—I think that the area of *aghani* has increased in this irrigated area since irrigation has been introduced.

74. *Q.* These works of yours consisted practically, did they not, in the re-opening of silted channels?—My work consisted chiefly in cutting across the silted areas into the old channels beyond the margin of silt from the new channel.

75. *Q.* The disused channels were owing to silting caused by floods?—Yes; my experience of the Kamla is that it throws silt for about 1½ miles.

76. *Q.* Have you any cases where the channels become disused owing to the erection of embankments to prevent floods?—No.

77. *Q.* Do you do anything in the way of well-irrigation?—In one village only. It is a large opium-growing village.

78. *Q.* And the other villages are they unsuited to it?—There is no demand for it. The *kachcha* wells fall in almost at once.

r. R. S. King.

79. *Q*. In this opium village are the wells all *kachcha*? —No, they are *pakka*. I have given them money to make them. It is a village of very high level and does not get water from flooding at all.

80. *Q*. And in these villages, which are of low level, do you think nothing useful could be done from wells?—I don't think so.

81. *Q*. Not even if wells were made for the growth of the valuable garden crops?—Very little of such garden crops is grown in this area. There is very little tobacco or such crops grown there.

82. *Q*. On what terms do you give your advances for wells?—We have given the money for wells simply as a present to them.

83. *Q*. You get no return?—They pay their rents regularly and they are good rayats. It was given as a matter of benevolence from the Maharaja.

84. *Q*. You get no increased rent?—We get a full rent for the opium lands, but it is not a specially high rent.

85. *Q*. It is not enhanced?—In no way on account of wells.

86. *Q*. (*Mr. Rajaratna Mudaliar.*)—On the lands irrigated by the channels you constructed in 1897, do you not levy any water-rate or any enhanced rent?—No.

87. *Q*. These 45,000 *bighas* are irrigated free, without any charge?—Yes.

88. *Q*. You have power to enhance the rent. Could you not have levied an extra charge?—I could have, but we did not ask for it. All we ask for is regular payment of the rents. The Maharaja has been very generous to the rayats in such matters, and we have dug tanks and made wells in that way.

89. *Q*. You don't endeavour to recoup yourself, or obtain at least the interest on the outlay?—No. Within the last year I have refused in some cases to make embankments, because I found the rayats took no care of them once they were made, and relied on us to make good many damages. So now I lend them money to make embankments; when they themselves make the embankments they take greater care of them, I find.

90. *Q*. Do you charge any interest on these loans?—At 12 or 12½ per cent., which is two annas on the rupee. The rayats understand it as a simple way of calculating. We lent them money in 1897 at 4 per cent and found they did not want to repay it, because it was at such low rates. They paid their *mahajans* some of this money and then asked for more money, because they could get it cheap, and I have recommended to the Maharaja not to lend money at less than 12½ per cent.

91. *Q*. (*The President.*)—Is that about the *bania's* rate?—The *bania's* rate is 25 per cent.

92. *Q*. (*Mr. Rajaratna Mudaliar.*)—On the land irrigated by your channel in 1897 you would have lost the rent but for the channels?—We could not have collected it in 1897-98. It would have had to have been postponed.

93. *Q*. I suppose you would not have succeeded in getting it all?—Probably we would have lost one-fourth of it.

94. *Q*. What was the cost of the channels?—In 1897 there was an expenditure of Rs. 10,000, including an embankment. The embankment cost Rs. 2,000 and the channels Rs. 8,000.

95. *Q*. You said that owing to the obstruction of a *malik* you were unable to extend your channels?—I was unable to close it. It was not the *malik* in whose land the channel was on, but an adjoining *malik*. He would not allow a spur to be made at the end of the embankment; hence the water swept round it and cut it away.

96. *Q*. In the case of these channels did you find any difficulty owing to the want of provision in the law for acquiring land in carrying out such work?—Through personal acquaintance with the locality, the rayats and the adjoining petty *maliks*, I find no difficulty. They have such confidence in us that they give us the lands. I have generally been able to persuade them.

97. *Q*. Do you think it would be an advantage to amend the law, so that, if there was a refractory tenant, you could compel him to give up the land?—We have not any question with the tenants, but only with the adjoining *maliks*. If we have to carry a distributary through some tenant's land, they generally give the land up willingly and we take it off the rent-roll.

98. *Q*. (*Mr. Muir-Mackenzie.*)—Do you think Government would meet with no more difficulty than you do? —I don't think so. I think the people would have more confidence in Government, and that the Collector could persuade them to give up the land.

99. *Q*. (*Mr. Rajaratna Mudaliar.*)—You have given some advances to tenants to make wells. In these cases also do you give them free of any increased rent?—Yes.

100. *Q*. (*Mr. Allen.*)—You spoke just now of Government being able to do this kind of work. Would not the tenants, as a matter of fact, want Government to pay much more than you pay?—They would undoubtedly do their best to get every pice they could out of Government.

101. *Q*. Do you think any Government officer would be able to carry out a scheme of this kind in the way you have done it? Is not this a case of your own personal influence?—I think it would require a man of experience and a great deal of application and time. You would need to have a special man for that one work alone.

102. *Q*. You have not anything like a water-rate here?—No. It was only levied once last year as a tentative measure, and I found so much difficulty and bother that I have decided not to have anything to do with it again.

103. *Q*. You don't levy any water-rate?—No.

104. *Q*. What is your opinion about that? Do you think the people would pay, say, Rs. 2 an acre for water in a dry year?—In a dry year they would pay Rs. 2 to get their rice crops in when they saw there was no chance of getting it in through the rains. At the last pinch they might do it, but they would not do it universally. Possibly 50 or 60 per cent. would do it, but I don't think they would pay unless put to the very last pinch about it.

105. *Q*. What is the rate of rents about that part?—About Rs. 4 per *bigha*.

106 *Q*. So that, if levied, the water-rate would represent about 50 per cent. on the rent?—Yes.

107. *Q*. Would there be any chance of people paying that every year? No chance at all.

108. *Q*. The enormous benefit you have caused to this country would only be felt in years of drought; you would only require it once in four or five years?—Yes.

109. *Q*. Is it not a permanent benefit?—It is a permanent benefit in opening up these river-beds, for since the channels were made in 1897 these villages (indicates on map) have had fuller crops than the adjoining villages. It means a difference of ⅛ to ¼ in the crops.

110. *Q*. Even in a year of good rainfall?—Yes.

111. *Q*. In a year of good rain you close these channels? —I close these running down here, Karh Malmal (map); this one (map), Arerh, I have left open. It is a 16-foot channel

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The Hon'ble Mr. D. B. Horn, Chief Engineer to the Government of Bengal.

(*Darbhanga, 31st October 1903.*)

Mr. D. B. Horn.

1. *Q*. (*The President.*)—You have heard all the evidence given at Bankipore by Mr. Toogood and other engineers. Are there any points in which you disagree with them?—No. I think all their evidence is very accurate.

2. *Q*. I wish to ascertain what the country has had to pay for the luxury of navigation on the Sone Canals. I understand it was about 20 per cent. of the total cost of the canals?—That is about the nearest approximation, I think, we can make. Navigation added about 25 per cent. to the cost of the Sone Canals. The locks cost about 30 lakhs, and I should say we could easily put down at least 20 lakhs more for other savings. Then for maintenance there must be a large percentage. There is all the establishment, and renewal of lock gates, etc. Gate renewals are very expensive. The cost is not so much in the Sone Canals as it would be in the tidal canals. The destruction of gates in tidal canals is very great.

3. *Q*. We asked Mr. Toogood wheather navigation was very much appreciated on the Sone Canals. He said "yes, the people like it." But his answer was given in a manner which led me to believe be was not very enthusiastic over it, and that he did not take it as a very great boon to the country. Do you consider it has been appreciated largely?—I dont think so.

Of course it has been a convenience to the people to have steamers running up and down the canal prior to the introduction of railways to the south. I might, however, say that, as far as the navigation is concerned, when I was at Buxar in 1987 I built a new *gola* at Sassaram and exporters would not use the *gola*.

4. *Q*. What do you call a *gola*?—A store-house for grain. I thought exporters would bring their grain to be packed and sent down to Buxar by canal. Instead of this I found they used carts and conveyed the grain down the Grand Trunk Road to Zammania in preference to the canal. I asked them why they did this, and they said "we have got our bullocks and we have got nothing for them to do. We prefer to use them instead of paying canal tolls."

5. *Q*. (*Sir Thomas Higham.*)—Do you have bullock traction on the canal?—No. It is all by hand. Navigation has been an absolute failure. I think, if we had made only one line navigable, it would have been sound; making all three canals navigable was a great mistake.

6. *Q*. (*The President.*)—About irrigation, you say the leases are taken up very readily?—Very readily, and of course the conditions are becoming more and more severe; we are getting more and more particular every year about the channels being properly kept up, and lease boundaries.

7. *Q*. What is exactly the basis of all leases?—We select a block. It may be all in one village, or it may be part of a village. If we have a very big village commanded by two or three distributaries, we may have several blocks in it.

8. *Q*. Would it embrace several villages?—No. As a rule, we confine a block on the Sone to one Village.

9. *Q*. You have got varying rates of irrigation according to the crop?—Not for the blocks. We have one uniform rate; inside the block a man can grow sugarcane, *rabi* and rice.

10. *Q*. What does he pay you?—He pays an all-round rate of Rs. 2-8 per acre for the block. If he wants hot-weather irrigation for sugarcane, he has to pay an extra hot-weather rate.

11. *Q*. In the event of irrigation being very popular, and there being a demand for it, would it be an easy matter to raise the rates for the new leases and make it Rs. 3 instead of Rs. 2-8 per acre?—We mean to do so when the existing seven-year leases fall out. I think they fall out next year.

12. *Q*. The whole of them?—A certain number will. We started seven-year leases in 1897. Formerly they were for five years.

13. *Q*. That will bring you presumably a considerable increase of revenue. Do you suppose that raising the rent will choke off many of the leases?—I don't think so. Our position is very strong. The villagers have got so accustomed to water and have realised its full value that I don't think we shall have any trouble at all. We increased the rate about seven years ago and there was no diminution. If you look at the list for the last 10 years, you will find that the leases are steadily increasing in number.

14. *Q*. What proportion of the whole irrigation is by lease?—I think about 85 per cent. *Rabi* irrigation varies enormously according to the season. The irrigation I am talking about is *kharif*. There is a proportion of *rabi* and sugarcane in the leases. They have got the right to grow *rabi* under the lease. When we started first of all the *rabi* area was very large, but when the villagors found that they were always ensured a supply of water, they have gradually converted *rabi* lands into rice lands.

15. *Q*. Is the sugarcane on the increase to any extent?—I don't think so. Sugarcane irrigation is not very much; we are restricted in the hot weather for supply. The Sone runs down to almost 300 cubic feet a second in May.

16. *Q*. To go back to my former question, what proportion of the irrigation is by lease; about 85 per cent. you say?—I should say quite that of the *kharif* area is under long lease. You heard, Sir Thomas, that the people are getting too much water. I was very pleased to hear that. When we had the Irrigation Committee in 1887, things generally were all the other way; that is to say, we were accused of not giving sufficient supply. We shall have to proceed very cautiously with the Shahabad cultivators. They are very troublesome.

17. *Q*. I gather it is not the policy of the canal authorities to fill the *ahars*?—Not at all. That is how we came to such trouble at first. We admitted water into a little undefined channel running into the lease, and what the villagers did was to let the water into their *ahars*, and then when we tried to assess the lands, they refused to pay and said "this is not your water; it is rain water," and we had no proof it was not. Then we adopted the policy of no leases except to good blocks with defined village channels.

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18. *Q*. If they came to you and said "we want to fill these *ahars*, for what will you do it?" When you have water going to waste you may just as well store it in the *ahars*?—We do fill *ahars* when we are closing the canal in the hot weather. We put water into the *ahars* for drinking purposes and for cattle.

19. *Q*. Might it not pay these people and add to your revenue, if you said "our leases are at Rs. 2-8 per acre; besides that, if you have got an *ahar*, we will keep it filled for you for so much"?—We have almost got to our limit now, and all our five-year leases are irrigated from proper channels and proper outlets.

20. *Q*. Do you think they would not irrigate further and would not make their blocks bigger, if there were store-houses for water in the shape of *ahars*?—I don't think so. It is a wasteful system of irrigation.

21. *Q*. I entirely agree with you that it is a wasteful system of irrigation in a case of short supply of water. But in a year when there is Sone water going out into the Ganges, it might be just as well as to store it, instead of letting it go to waste?—We don't waste any water.

22. *Q*. During the floods?—We close down.

23. *Q*. During the last year of scarcity, if your *ahars* had all been full, they might have pulled you over this difficulty. Would it not have been an advantage?—We have had a bad experience of *ahars*. There is constant friction between the villagers and ourselves about losing control of our water.

24. *Q*. (*Mr. Muir-Mackenzie.*)—How exactly do you lose control of the water?—At first we allowed water to leases with imperfect village channels, and the villagers used to take it down into these *ahars* and irrigate their land which was not within the lease at all. When we tried to assess them, they said, "it is not your water; it is rain water." We could not prove it was not rain water. There might have been rain water in the *ahar* in an ordinary year.

25. *Q*. Could not you give water to the *ahar* on condition that any new area irrigated from the *ahar* was charged for?—I think all the area pretty well commanded now is under lease. I also understand that the *ahars* are falling into disuse.

26. *Q*. It is in evidence that you may have a large surplus of water in the early part of the year, and then at the *hathia* when you may want every single drop you have got. If you could store the water in *ahars* in the early part of the year, you could guard to a certain extent against the eventuality of having all your water exhausted?—We have only had this experience once in 30 years, and I think, if we begin to let water into the *ahars* again, we would gradually work back to the old system and lose control of our water. These *ahars* are scattered all across the country, and those of one village are connected with those of another. It is a most complicated system. We have accepted this principle now that, if we lose control of our water, we cannot assess.

27. *Q*. Mr. Toogood seemed hardly to have accepted that principle?—I don't know. In the Eastern Sone it is very sandy soil.

28. *Q*. (*Sir Thomas Higham.*)—Are you speaking of *ahars* in the middle of a block or outside?—A block may be above the *ahar* or below the *ahar*.

29. *Q*. There is no objection to their filling *ahars* in the block?—But these *ahars* go into other villages which may not have a lease.

30. *Q*. What is your objecion to charging a fee for filling them? I am not speaking of outside *ahars*, but supposing a man who had an *ahar* in a block came to you and said "I will give you a rupee if you fill this *ahar*." What is the objection to that?—I don't think he would come forward, and besides, I say, that once you lose control of your water, you are helpless.

31. *Q*. You would not lose control of your water in that case. The difficulty I see is what you say that when you irrigate from an *ahar* you cannot say whether the *ahar* was filled by rain water or canal water. But if a man comes to you and says "I have not got much rain water in my *ahar*, put a couple of feet into it, where is the difficulty?—We have tried selling water by volume, but I don't think it has ever come to very much.

32. *Q*. Before the *hathia* you have a lot of water?—Yes, there is never any lack of water for transplanting the rice.

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33. *Q*. You have a great deal more water than you want before the *hathia*, and you don't seem to be able to do anything with it?- In a favourable year these *ahars* are filled by the rain, and the people won't ask for water outside the lease until the rains fail.

34. *Q*. But supposing it were a dry year?—How are we going to know when the *hathia* is going to fail.

35. *Q*. You mean to say the people will not apply? —Yes. They have got these *ahars* and they always contain rain water in the season, and very likely they also contain water from our five years leases. It is only in a very dry September that they fail and the villagers would never apply to have them filled until it was too late.

36. *Q*. You don't sell water by volume?—When leases come in late and we don't want to measure, we say- "We will keep an outlet open for you for 24 hours at so much," but I think very little has been done in that way.

37. *Q*. Supposing it were generally known that where there were no leases, if the people liked to apply for water for their *ahars* before the *hathia*, you would be prepared to fill them up at so much a thousand cubic feet, would they apply?—They won't apply before the *hathia*. That is what led to our long lease system being introduced. We found that these people would wait till the last moment until the middle of October and then they often got water too late to benefit the crop for which remission of water rate had to be given.

38. *Q*. Would they pay a definite sum to have their *ahars* filled up?—Filling the *ahars* would only benefit the unleased areas beyond the long lease area, and the villagers would never apply until the *hathia* had failed when no surplus water would be available.

39. *Q*. Why not let them apply for their *ahars* for five years? Why not have a five-year lease for *ahars* also?—In my opinion this would be a retrograde step in canal administration.

40. *Q*. You have certain years of drought. They are not very common perhaps, but say they take place once in five years. You propose to reduce the size of your outlets and so raise the duty. Would not the pressure be greater in these exceptional years than you have ever had?—I don't think so. The people are very extravagant in the use of water at present.

41. *Q*. The more you raise the duty, the more the tension comes on at the times of trial?—I don't think so. They will know they have only got an outlet open for a certain number of days and they will take good care to irrigate their land within that period. At present the outlet is ten days opened and five days closed in the *hathia*. We hope to reduce it and make it, say, nine days open and six days closed. That will spare a good deal of water and enable us to irrigate more than we can now.

42. *Q*. You will ultimately come to your limit- -Yes.

43. *Q*. You have got a very good duty out of that; 86 acres?—We only get 50 in a year of bad *hathia*.

44. *Q*. The capacity of canals is dependent upon the amount of water you can get down your canal during the *hathia*?- It is only since we have started to work on the Sone system that we have found out that fact.

45. *Q*. You say that the average actually has been 86 acres?—Yes, 80 at the outlet, but all these duties that are based on the four months' discharge are quite misleading .

46. *Q*. (*The President*.)—We know that you are interested in the Karamnassa project. I suppose that if you can command the establishment, you will have it surveyed?—Mr. Toogood and Mr. Harris are going up in the middle of next month to see the sites. I have written to find out if any of the agents of the Maharaja of Benares know the country and whether it is open, so that I may have some contours taken to find out what the capacity of the reservoir is likely to be.

47. *Q*. (*Mr. Muir-Mackenzie*.)—I see in the month of September that in the Sassaram Sub-division the average rainfall is 7 :5 inches. In the year 1892 it went down to 2 : 42. In a year like that would the people not apply to have their *ahars* filled?—No, I don't think so. In fact, as I say, their *ahars* are gradually being done away with.

48. *Q*. (*The President*.)—To go back to the Karamnassa. Do you contemplate that it possibly might help the Sone system?—The original idea was to carry on the main western canal through Sassaram up to the Karamnassa and on to Mirzapore. This was stopped, because, as I said in my note, we had not sufficient water in the Sone, so the Karamnassa project is now proposed. The Karamnassa is the river on the extreme west of the district. Instead of taking the water from the Sone towards the Karamnassa, water will be brought from the Karamnassa back to the Dargaoti into all that Bhabua tract which we know is very liable to scarcity of rain. In Bhabua, in my note, I have shown that the *hathia* rain failed about 12 times in the last 20 years. If you go lower down into Midnapore, you will find there were only two bad years in 20; in Cuttack there were about two bad years and one doubtful year in 20; whereas, every alternate year in Bhabua has a failure of the rainfall which is required to bring the rice into ear.

49. *Q*. To go on to Champaran and Saran, this side of the Ganges, I understand that you look on the Saran project as altogether a very doubtful one; I mean these canals from the Gandak?—They have proved most unsatisfactory, and I don't know quite what the reason is. They have been working for 20 years, and I suppose one of the defects of the scheme was that there was no regulator in the *sota*.

50. *Q*. I gathered from one of the witnesses at Muzaffarpur that at one time, when they wanted the canals opened in a hurry, the channels had silted up, and thus the opening was delayed for six weeks. It was then too late, and they did not care to take the water. That could not have happened if there had been a regular establishment maintained by the Government or the District Board whose duty it would have been to see to the silt clearances. I don't think one has a right to say that it was a hopeless case, because it has not been very successful hitherto from want of management?—I think it is really worth while to investigate it and draw up some scheme that would bring it more into line with the Sone. You would have to construct a regulator outside the embankment in the first place, but without a survey it is impossible to say what additional works are required.

51. *Q*. From these rainfall statements I make out that every third year here is a year of drought. For instance, in Gopalgunge, in 20 years, there have been six bad years, 11 good and three doubtful ones, which were pretty near bordering on the bad years?—Yes; and Gopalgunge is pretty central for this Saran district. I think from the evidence and from the rainfall statements it is clear that irrigation for the rice crop is necessary more frequently than the witnesses at Saran made out.

52. *Q*. I would even go further and say that the fact that the works existed at all, being left to themselves without the controlling hand of an engineer, gives one a fair reason to hope that in better hands they might be a success. What do you think?—I think it is very well worth inquiring into. The local Government has spent 7 lakhs, and I think we might safely spend a little more money in the hope of making the scheme a success. At the present moment all this money is simply sunk and lying idle.

53. *Q*. Did Mr. MacCarthy say that gauge-readers were kept up on the Gandak?—I am not quite sure that he is accurate in what he said about gauge observations in the Gandak. It is most essential to have observations taken in all rivers likely to be utilized such as the Kamla and Bagmati. I think the District Boards might spend a little money in this way. It would not cost much to have one or two gauges established on these rivers.

54. *Q*. What do you think of the Tribeni scheme?—It is going on. Mr. Butler hopes to do very well this year. The tract is unhealthy; it is feverish, and the coolies gave it a bad name last year. I think more perfect arrangements have been made this year for pushing on the work.

55. *Q*. How are you getting rid of the cross drainage?—In some places the canal is syphoned and in others carried in aqueducts.

56. *Q*. Have you got funds to carry it on as fast as you wish?—Sir Thomas Higham says we can get any money we like. We have got six lakhs this year, but he says we need not be tied down to six lakhs; we can get ten lakhs if we like.

57. Q. What is the amount of the estimate? —Rs. 37,91,000, including establishment.

58. *Q*. Do you consider this Tilari project promising one?—I am afraid not. From Mr. Maconchy's report it will be seen he is very decided and expresses himself very strongly against it.

59. *Q*. Then what do you think of these three projects,—the Tilari, the Bakhiya and Pussa?—I am afraid they would fail just at the time water was required. They are small streams and could be very easily bunded up above by the Nepalese.

60. *Q.*—Mr. Maconochy in his report says:—"The Dous scheme may, perhaps, be placed in the same category; for, although there were two *bunds* across the nullah in Nepal, there were also three *bunds* in British territory, showing that there was some water to utilize for irrigation." What do you say?—I agree.

61. *Q.* What is your opinion as regards the Bagmati?—The floods are the great obstacle here. This canal runs right across the drainage of the country, and as it is not possible to construct flood embankments in Nepalese territory, the irrigable area could not be protected as is the case in Orissa.

62. *Q.* Then you reserve your opinion about the Bagmati till more is known about it?—I think the suggestion that Mr. Disney made is worth inquiring into. That does not interfere with the cross drainage in any way.

63. *Q.* (*Sir Thomas Higham.*)—That is working on the same lines as Mr. King has been doing?—Yes.

64. *Q.* You have spent Rs. 52,000 on *pains* and cuts for making these canals?—Yes.

65. *Q.* (*The President.*)—Do you think there are any of these rivers we can leave out of consideration at once, or do you think it is an open question with regard to them all whether they can be utilized?—I think these four—the Tilari, the Pussa, the Bakhiya and the Dhaus might be obliterated, as they would fail just when required.

66. *Q* Anyhow you would put them in a second line giving preference to the others?—Yes. As regards the Bagmati Mr. Buckley and Colonel Haig have always admitted that a weir is essential across the river and therefore you must get as big an area as you can to irrigate. As far as I have read the old papers, no one seems to have dealt with this question of carrying the canal across the whole of the drainage of the country which is itself liable to heavy floods.

67. *Q.* (*Sir Thomas Higham.*)—You say there is some scope for work of the same kind as Mr. King has been doing?—Yes.

68. *Q.* That consists of carrying out works according to the exigencies of the season. They may go, I understand, for two or three years without doing anything with these canals?—Very likely.

69. *Q.* Then when they know there is a demand likely to come on they set to work and open a channel where it is required and make a *bund*?—Yes. After the season is over they put a *bund* across the mouth to keep the silt out in years when the channel is not required.

70. *Q.* The Public Works Department are aiming at making an arrangement which will involve a heavy capital cost, and then be more or less permanent. But for a work like Mr. King's work, you will require men on the spot able to see at once what is to be done for the season, and who must be able to lay their hands on money at once?—Quite so.

71. *Q.* I don't know how such a scheme could be worked except by a District Engineer?—That is how it should be done. You could not dream of working it in any other way.

72. *Q.* I don't see what is to prevent its breaking down as the Saran Canals have broken down?—The Saran Canals have been working in very much the same way.

The President.—They had not got a Mr. King there?—That is the difference.

73. *Q.* (*Sir Thomas Higham.*)—There is this danger, I suppose, that a season may come when you cannot get control over the water?—Yes, and when that time comes, then the question of a permanent regulator will have to be considered. Of course Mr. King was getting water all through September. His scheme has therefore got that great advantage over the Saran Canals.

74. *Q.* You could get water all through September in the Saran Canals?—Not to the same extent as he did.

75. *Q.* There is lots of water in the *sota*. What is to prevent your opening the sluices?—I should think there is a good deal of silt in the *sota* after each freshet. He got supply from the main river.

76. *Q.* You mean in Saran?—Yes. I don't think they ever opened the sluices until October in the Saran Canals. They cannot bund the *sota* until the river falls to a certain level.

77. *Q.* There is no reason why they should not be?—We have come to a deadlock now. The Government is not going to spend any more money on maintenance and the zamindars won't pay the maintenance charges. The canals are only opened now when the civil officer says it is absolutely necessary to save the rice crop.

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78. *Q.* That is why they are never opened until October?—We did sanction the opening of them this year in September, because there was not sufficient water to do the transplanting, but we told them we could not open them in October again unless they paid some money for the cost of clearing the channels, so we are now absolutely at a deadlock.

79. *Q.* They have paid nothing?—They pay nothing.

80. *Q.* Are they open now? Has anything been done to shut the water down?

(*Mr. Hare.*)—They are open now.

81. *Q.* You have not got your contribution?

(*Mr. Hare.*)—No, they may be closed now. I am not quite sure.

(*Witness.*)—I think they are closed. I could not be certain, but I think they must be closed.

82. *Q.* Has any money been paid for this year.

(*Mr. Hare.*)—No.

83. *Q.* (*Sir Thomas Higham.*)—The Tilari project is probably hung up, because there is no certainty as to supply?—Yes.

84. *Q.* How much water do you want for that?—50,000 acres is the area commanded; 200 acres of *kharif* to the square mile would mean 60,000 acres.

85. *Q.* How much water is wanted?—300 cubic feet.

86. *Q.* Would it be possible to send that volume down the Tribeni?—We are having a lot of demands on us now for the Tribeni.

87. *Q.* I suppose you could make it as large as you liked?—We propose to extend the Tribeni. We have raised it up to 2,170 cusecs, but we have another demand across the Sikrana. I should like to get across the Sikrana and Tilari.

88. *Q.* You could not go across the Tilari?—I have no personal knowledge of the district.

89. *Q.* Is it too late to consider the question of enlarging the size of your syphons, so that, if you want to carry out these doubtful schemes, you will have the water there?—We would have to provide altogether for another 40,000 acres; that would be about 800 cubic feet.

90. *Q.* Your syphons are now devised for a full supply of 2,170 cusecs?—Yes.

91. *Q.* They consist of 6 feet barrels. If you were to make all those barrels 8 feet, you could increase the capacity of the syphons by ⅓. It is not too late to do that?—No.

92. *Q.* Do you think it would be worth while doing that?—I don't know if the money is available. It is certainly worth considering.

Sir Thomas Higham.—I don't think there would be any difficulty in getting the money for it.

93. *Q.* (The President.)—I suppose, if 4,000 cubic feet were wanted, you could have it there. There is no limit?—No, there is no limit; but we might have eventually, I cannot say, to build a regulator.

94. *Q.* Then you think it worth while to increase the size of the syphons?—I think so. We only provide for 200 acres to the square mile at present. It is said to be a good rice country and only wants to get water to produce 250 or 300 acres to the square mile.

95. *Q.* (*Sir Thomas Higham.*)—You have not worked up to that on the Sone?—No. We have only worked up to 138 acres to the square mile there.

96. *Q.* We have heard that the Saran Canals have been known to irrigate 22,000 acres in one very dry year. Can you say how they got hold of the figures?—I don't know. I believe they did try to assess the rayats, but they could not realise anything.

97. *Q.* How did they try to realise?—I presume they had some sort of measurement. But as regards that 22,000 acres, I don't know how reliable it is.

98. *Q.* How is one to find out?—I dare say Colonel Hoddling could tell us.

99. *Q.* The Irrigation Department put all these areas in their reports. Where did they get their figures from?—I don't know.

100. *Q.* It is said that a portion of the area irrigated by the Sone Canals was never paid for; that it was outside the blocks; have you got anything to say about that?—A rayat may pass water on his field to outside areas.

101. *Q.* How does he get the water on to his field?—From the village channel.

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102. *Q.* He lets the water go on to other land; that land gets a crop and pays nothing?—These people may be equally anxious to get rid of the water before the *hathia*, so it would be a disadvantage then, as it might do harm.

103. *Q.* Does much irrigation go on in that way that is not paid for?—I don't know.

Mr. Muir-Mackenzie.—Mr. Toogood said there was a substantial amount in the Eastern Sone Division. I have since ascertained that it is about 4,400 acres a year in the circle.

104. *Q.* (*Sir Thomas Higham.*)—You don't think that is an important question?—No; we have got our value for the water given.

105. *Q.* In reference to the works that have been done on the Bagmati, do you recommend the cut being completed to see what could be done with it?—I think it should be inquired into.

106. *Q.* The District Engineer could say what he proposes to do with it?—Yes.

107. *Q.* I understand he wishes to work up in connection with these two rivers?—I don't think there is any field work done. Mr. Disney's proposals are not based on actual surveys; they are simply in the air.

108. *Q.* Should it be done by the Public Works Department or the District Engineer?—It might be taken up by the District Board.

109. *Q.* (*Mr. Rajaratna Mudaliar.*)—With regard to what you said about the block being drained, what is the area of rice under the Sone Canals?—320,000 acres are irrigated.

110. *Q.* If all that water is to be drained, it would be capable of irrigating an appreciably large area outside the blocks?—Yes, the people don't want water when they let it go; they always want to dry their fields 15 days before the *hathia* begins.

111. *Q.* Does this water benefit the crops outside the block?—It does not; everybody wants to get rid of the water at the same time.

112. *Q.* The area outside the blocks are not likely to have over much irrigation; are they?

113. *Q.* (*The President.*)—Our experience on the Nile was that the water used in rice irrigation always washed a certain amount of salt from the soil and did harm if we attempted to irrigate twice with the same water?—I have had no experience of that.

114. Q. If you constructed drains to carry off water, would the people outside the block areas be induced to apply for water?—I consider the acres irrigated outside the blocks unimportant.

115. *Q.* (*Mr. Muir-Mackenzie.*)—Mr. Toogood said that the amount of land that obtained water in this way was in one part of the Sone so great that it checked irrigation?—The eastern side is very backward and the soil is very sandy and uses more water; there is not the same hold over the water; whether it is due to the individual officer I am not prepared to say; it is 12 years since I left the Sone.

116. *Q.* (*Mr. Rajaratna Mudaliar.*)—If water is stolen, have you no power to charge water-rates?—If it was due to carelessness on the part of the canal staff, I should punish them.

117. *Q.* You have a separate measuring staff and a separate staff for collecting; do you see any objection to the Deputy Collectors checking the measurements of the separate staff?—I don't think they could for want of training.

118. *Q.* Could not Deputy Collectors and Sub-Deputy Collectors be trained to check measurements?—With what object?

119. *Q.* For the sake of efficiency?—There is sufficient efficiency now. All our collections are got in in time.

120. *Q.* It is a question whether the whole of the amount is got in?—Our men are better able to do it; though they may not check each individual field they know the area of the block.

121. *Q.* Is your block properly demarcated?—Yes.

122. *Q.* (*Mr. Allen.*)—You said that the cost of keeping up navigation on the Sone was considerable. Would you recommend the abandonment of navigation on the Sone?—Not at present; when the lock gates require to be renewed, it may be considered. We are reducing the number of men all round, but we must keep up the lock gates as they are. I probably exaggerated in saying that it costs a great deal. It does not cost as much as I at first imagined.

123. *Q.* You would not drop it altogether?—I certainly should not.

124. *Q.* We have had some evidence about the small area of *rabi* irrigated from the Sone Canals; don't you think, as a matter of fact, the *rabi* has been extinguished by the extension of *aghani*?—That is true to a great extent in the long lease areas; but if there is a bad *hathia* on all the western side of Shahabad, we get a large *rabi* area.

125. *Q.* The tendency of regular irrigation must be to cut down the *rabi*?—Yes, at first it was 30 per cent. in every five-year lease; now it is much less.

126. *Q.* With regard to what you said about the Karamnassa, do you propose to inspect the Durgaoti scheme also?—Yes, I don't think I shall be able to contour the reservoir site this season.

127. *Q.* Why?—For want of staff. I mean to try and get it done. I am not certain what staff will be required for the Karamnassa.

128. *Q.* We have heard of the prospect of investigating certain small schemes in the Terai similar to Mr. King's; have you a staff of engineers to do that work?—I am afraid not, but the District Engineers have got a good deal of local knowledge. I should require a survey staff as well.

129. *Q.* Have you the material to organize a survey staff? You have the Karamnassa, Durgaoti and other schemes along the Himalayas?—No. I think the District Engineers could give a good deal of assistance there.

130. *Q.* I think the answer is, you have not sufficient men?—Not to take them all up at one time.

131. *Q.* What class of men would you require as regards these minor schemes?—Temporary surveyors, once having settled the lines on which we are going to work; it would not take long to survey and level these lines; the question is, who is going to provide funds for the investigation. I have since decided to give money from Imperial and Provincial Funds.

132. *Q.* Mr. King spoke about detailed examination and personal trouble taken. It does not appear that the survey could be done quickly?—I think he refers to the distribution of water.

133. *Q.* (*The President.*)—Have your canal officers on the Sone Canals got magisterial powers under the Canals Act?—Yes.

134. *Q.* Do they exercise these powers?—To a very limited extent.

135. *Q.* There are certain penalties for breach of certain sections of the Canals Act?—Yes.

Mr. L. Hare.

Mr. L. Hare, Commissioner, Patna Division.

(*Darbhanga, 31st October 1902.*)

Note on Irrigation Works.

1. I have nothing to add to the particular information supplied by the District Officers in their replies to the questions of the Commission.

2. I would wish to bring to notice the desirability of legislation to give power to the Collector to interfere in case of the construction of *bunds* in rivers—

(*a*) In order to prevent disputes and rioting.

(*b*) To prevent unreasonable waste of water to the detriment of those who live lower down the river.

(*c*) To prevent grave and material alterations in and diversions of the rivers which may seriously affect the country.

3. I would recommend definite recognition and acceptance for the principle that, in the case of schemes in which the demand for water is intermittent, and consequently the receipts from the sale of water are irregular and uncertain, a cess should be levied on the lands protected by the scheme—

(*a*) The benefits are so great as to secure ample return to the cess-payers.

(*b*) The payment is in the nature of an insurance against failure of crops and famine which should be borne by the area protected.

4. It would be necessary to legislate. The amount of cess so leviable would be limited by the Act. It should be paid for five years at a time, and so calculated that, with the receipts from the sale of water, it should cover working expenses and a reasonable interest on the capital expenditure.

5. I would levy the cess direct from the occupiers along with the demands for water supplied in the same manner as the present canal dues are levied.

6. This proposal would apply to schemes prepared by Government. I would at the same time provide for the case in which application was made for irrigation works on lines corresponding to those of the Bengal Drainage Act, *i.e.*, suitable schemes approved by Government would be carried out in a tract where the majority of the persons interested accepted the scheme.

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1. *Q.* (*The President.*)—Mr. Maddox in his paper says:—"I notice that the total cost of famines since 1873-74 has been Rs. 76,18,274, excluding the amount spent by the Maharaja in 1875-76." That is in the one district of Darbhanga?—Yes.

2. *Q.* Has there been fairly good value obtained for that?—No, except as regards saving of life.

3. *Q.* Would it be a fair test of the intensity of famine in the different districts to compare the amount spent on relief works?—It will be much fairer in future, as there will be a Commissioner appointed under the Code to ensure a uniform system.

4. *Q.* Are your programmes of relief works complete?—I think we should have more schemes which give a promise of being really useful, worked out in detail and kept ready. In the past famines we have been, I think, too apt to select works which were convenient and not those of real value.

5. *Q.* (*Mr. Muir-Mackenzie.*)—That was, I suppose, largely owing to want of time?—Yes, to some extent, and also to the idiosyncrasy of the officer dealing with the subject.

6. *Q.* (*The President.*)—The tendency has been more and more to give relief in much larger proportions?—It is much more difficult now to resist applications for relief.

7. *Q* There was more relief in 1896 than in 1876?—No, I think it is the other way.

8. *Q.* Are you satisfied with the system on the Sone Canals with the amount of revenue authority possessed by the canal engineers?—I think the system is working very well.

9. *Q.* Are the relations of the district and canal officers quite satisfactory?—Yes, quite. When the Lieutenant-Governor went down the year before last there were crowds at every lock, but there were no complaints, merely petitions to get water a little cheaper.

10. *Q.* There were no complaints of injustice or hardship?—No.

11. *Q.* You have no doubt of the importance of providing the Bhabua Sub-division with a supply of water?—None whatever.

12. *Q.* I think your opinion is that in the Saran Canals a cess would be acceptable?—I think so if you can show that you are giving them value. Whether accepted or not, I think it should be levied if you can give them value. In that case we would have to meet an outcry, a paper outcry, not from the people concerned; there would be strong objection in the Legislative Council.

13. *Q.* An argument used would be that all had to pay, although all did not benefit equally?—Yes, that would be one line. I should levy it locally if the scheme gave only local benefit.

14. *Q.* In those cases where irrigation would only be taken at intervals of a few years, do you think that would be a preferable way of raising Government revenue to a water-rate on the area?—If you had proper control over the water and a definite scheme, I would prefer a water-rate on the area, levying so much on the water taken; but if not, I would prefer a cess on the whole district—every man would benefit. It must be a small cess of course.

15. *Q.* What should the maximum be?—Half an anna on the rupee to begin with.

16. *Q.* (*Mr. Muir-Mackenzie.*)—With regard to the severity of the famine, I see an enormous difference in the figures that are given as regards the numbers on relief in 1873-74 and 1896-97. For instance, in Darbhanga, the numbers on relief in 1873-74 was 55 million and in 1896-97 the figure was 22½ million. Was the famine of 1896-97 as severe as that of 1873-74?—I could not say. Planters who were present at both say they were of equal severity.

17. *Q.* As regards failure of crops?—The failure of crops was more severe in 1896-97.

18. *Q.* Has the opening up of the country by railways and greater facilities of communication made any great difference?—I think it has made a great deal of difference in the resisting power of the people.

19. *Q.* Can we take it that you are not likely to have a more severe famine than you had in 1896-97?—I think it is possible you could have a more severe famine if you had three successive bad years.

20. *Q.* Have three bad years in succession ever been known in the district?—I don't think so.

21. *Q.* (*The President.*)—I suppose prices never rose in 1896-97 to the 1873-74 rates?—No. The increase was not so great. The average prices are now so much higher.

22. *Q.* (*Mr. Muir-Mackenzie.*)—In the famine programme paper we are given proportions of the population for whom work is provided for each district. Are you satisfied that their proportions are properly adjusted to the requirements of each district? I find that in Muzaffarpur work was provided for 80,412 persons, and the average number employed in the famine of 1896-97 was 31,424?—I think the number provided for might have been lessened there.

23. *Q.* In Darbhanga also the number provided for is 176,380, whereas the number employed only works out to 82,461. Again in Champaran provision is made for 177,229 persons and the average number in the famine was 53,685?—The work is for the whole district and relief may be wanted in only one or two places. I think a great many of the works would be weeded out eventually. The idea is to leave a large margin.

24. *Q.* I suppose the ideal to aim at is to have no work that is not useful?—Yes. I would even go to the extent of taking men away a considerable distance for good works. I would sacrifice more to the importance of the work.

25. *Q.* You don't think it is impracticable to convey people about in this way?—No; in this district you could take the cream of the labour away. The real labouring class are the first to come on relief; these men are accustomed to travel about. That would leave small works to be carried out by inferior labour.

26. *Q.* Would you say that it is preferable to have large and extensive works and run the risk of people being on them who did not require relief?—I would simply bring the people together, presuming that the work was necessary.

27. *Q.* I understand you to wish to take advantage of your good time to prepare a complete survey of useful works?—Yes, for such works as the Collector is not an expert upon; he knows roads, but not canals.

28. *Q.* You want, if necessary, to have the aid of professional skill through the Public Works Department for the purpose?—Yes, not only for relief purposes, but because I would like to take a few up in advance.

29. *Q.* Would you like to see the Saran Canal works undertaken by the District Board?—I do not care who has the control, so long as the local officer has full control and is not required to refer to Calcutta at critical times. If there is to be a cess, whatever the proceeds they should be handed over to the District Board.

Mr. Allen explained that the law was an obstacle in such a case.

(*Witness.*)—Where we have got to legislate for collecting the cess, we might as well by executive order prevent the District Board spending its present cess on irrigation.

30. *Q.* (*Mr. Muir-Mackenzie.*)—Some of the planters mentioned that the District Board had to spend periodically large sums on relief works; has that actually been the case?—No, but Government has power to insist on every penny going to relief works. Sir Charles Elliott insisted on it in 1892, but Sir Alexander Mackenzie let them off.

31. *Q.* I understand the Board starts a work when famine is expected; have any substantial sums been spent

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in that way?—In Muzaffarpur we spent something more than a lakh. I cannot remember the exact amount.

32. *Q.* The District Boards seem to be liable in years of moderate scarcity to be called upon to provide work which it might not want simply on the chance of people wanting relief?—Yes.

33. *Q.* Is there any way of getting at the actual sums spent?—I think I can get them for you.

34. *Q.* Has the Local Board always to set apart a sum on account of this danger?—No, not unless the warning note is given.

35. *Q.* In Shahabad I think you said there is no doubt of the necessity for irrigation. Is there any doubt that water will be taken?—In that I must trust the local men. I think it will be taken. I did not go into the question, as I was told that no reservoir was possible.

36. *Q.* Do you think they would pay the Sone Canal rates?—Yes.

37. *Q.* At once?—Yes, I think so; they would not take a great quantity of water at first.

38. *Q.* I observe from the famine map that nowhere through the sub-division was relief extended to more than six per cent. of the population; is that not a sign that distress is never very intense?—They always live poorly. Every year they go away to get their living, not only in famine years.

39. *Q.* If the Karamnassa scheme is impossible, is there any chance of saving the country by the extension of small works?—Yes, there are other schemes which might be gone into like the Durgaoti. Something could be done also with *pains* and cuts into low lands.

40. *Q.* For the Gya district I understand there is no large work?—No; if there is a proper survey, I have no doubt a good deal of work could be found.

41. *Q.* Some of the *pains* appear to be large works; would it be worth while to have the country surveyed and put under Government management?—The question of Government's interference must come up if the estatetes are subdivided more and more.

42. *Q.* Do you support Mr. Oldham in his proposals on that point?—Yes.

43. *Q.* Do you support his proposal that the Collector should have the power to compel zamindars to carry out repairs?—Yes.

44. *Q.* For small *ahars* as well as small *bunds*?—I should not use it if I was Collector unless the Executive Engineer said it was necessary.

45. *Q.* Would you give him an inspecting officer?—Yes, I think that is necessary, because a Collector with the best intentions might do harm in pushing schemes which he thought good, but which really were not good.

46. *Q.* Would you like him in the case of *pains* to act in anticipation of complaint?—He would act on the complaint of the Inspecting Officer.

47. *Q.* I mean complaint on the part of the people?—I don't think that would ever happen.

48. *Q.* If the Collector is given this power, would he have to proceed often to extremes?—No, not often, but to give him the power which would serve a useful purpose.

49. *Q.* Do you think in a district like Gya, with a lot of complicated rights in water, it would be possible to have a record-of-rights?—I would have a record of the facts.

50. *Q.* You would not determine the rights?—No, I would allow the Collector to give an *ad interim* order; he might state the case and then it should go before the Civil Courts. There are some disputes he could not decide.

51. *Q.* Would it not be advisable for the proper husbanding of the water that the Collector should lay down how the stream should be divided?—I should not allow him to do more than pass temporary orders. He can determine all the facts, but not the effects of the facts. I would not allow him to make a record-of-rights.

52. *Q.* Patna, I understand, we may consider to be immune from famine?—I do not think we can say that everything possible has been done. If the Collector were assisted by expert advise, he could get a great deal done by the people themselves.

53. *Q.* To recur to the question of a record-of-rights, in cases where a right of water has been made out and the existence of such a right obstructs the administration of the stream to the best advantage of the public in general, would you advocate that Government should have power to acquire the rights in that water, just as it can now acquire rights in land?—Yes, where a man had already a vested right, Government might acquire a right to the balance over and above what the man could fairly appropriate.

54. *Q.* If a man were obstructive, why should not his rights be taken away altogether?—That would be very expensive.

55. *Q.* Not necessarily more expensive than rights in land. You would give the man compensation for the appropriation and the value of the rights?—I would reserve to him all you possibly could consistently with using the stream to the best advantage.

56. *Q.* Regarding the repairs of *pains* and *ahars* and other small irrigation works, is it generally the duty of the zamindar to repair?—That is the theory no doubt.

57. *Q.* Has it been accepted by the Courts?—I cannot say; I do not know of any case where the rayats have sought to get it enforced.

58. *Q.* Would the zamindars generally accept it if it came to putting it down in the record-of-rights?—Some would and some would not.

59. *Q.* Would it be safe generally to record it as the duty of the zamindar?—Yes, though they have shirked it a great deal.

60. *Q.* Are there any duties on the part of the rayats in customary labour?—Yes.

61. *Q.* In Gya we heard of the *gohan*, a levy of labour in cases of emergency. Is that the limit?—As far as I know, it is. I do not know the Gya district very much.

62. *Q.* Is that confined to the Gya district?—There is, I think, something of the kind in Patna.

63. *Q.* In Saran in the famine I notice that the average number on relief for 1896-97 was only 14,000. That looks as if the famine must have been slight?—Yes. They helped themselves to a great extent by emigrating and sending back their money.

64. *Q.* Are there plenty of outlets for that emigration?—The men went out in large numbers, but did not all succeed in getting work.

65. *Q.* Have you been able to form any opinion as to the chance of getting anything like a hundred thousand acres under the Saran Canal?—No.

66. *Q.* Is there any reason to suppose that, before the embankment was made and when the channels were allowed to do their duty unimpeded, there was anything like that area under irrigation?—The cultivation must have been very different in those days. There must have been constant floods.

67. *Q.* There are no remains of any works of *ahars* or *pains*?—No.

68. *Q.* (*The President.*)—They were devastating floods, I suppose?—I understand so.

69. *Q.* (*Mr. Muir-Mackenzie.*)—Is there any reason to suppose that these embankments have really cut off a very large amount of irrigation?—It has altered the nature of the country. There are no floods now.

70. *Q.* Were the floods useful?—Of course they strengthened the ground, but the people often lost their crops.

71. *Q.* Did they bring down silt?—Yes.

72. *Q.* In other parts of the country sometimes the flooded land is the only land where there is crop in time of famine. There is a considerable amount of well-irrigation in parts of Saran?—Yes.

73. *Q.* Is there any chance of a material extension?—I should think so; very considerable.

74. *Q.* What measures would you propose?—I would encourage rayats to take advances. A good many zamindars are rayats themselves with small holdings.

75. *Q.* To go to Champaran, when the Tribeni Canal is being made; will that fully protect the district?—It will make an enormous difference, but there was very large relief given outside the Tribeni area.

76. *Q.* There will no doubt be a movement into the Tribeni tract during a famine?—Certainly I find that the effect of a canal extends to a considerable distance beyond the area actually covered by the canal. It means a great deal that within the canal tract all charity is not cut off.

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77. *Q.* If you cannot say confidently that it will be a complete protection, it will be a very large measure of protection?—Yes.

78. *Q.* Do you feel confident that the people in Champaran will take the Tribeni water in an ordinary year?—I do not think there is enough cultivation to take it all at present, but the cultivation will extend. The question is—when it does extend will the health of the district improve?—At present the Saran men, although they are so crowded, are very unwilling to go up there. There must be a great deal of immigration from somewhere before the whole area can be taken up.

79. *Q.* There are considerable areas of waste and the country is unhealthly?—Yes.

80. *Q* Is water wanted very often there?—They cannot cultivate the whole of their holdings without it even in ordinary years.

81. *Q.* Does Champaran differ very much from Muzaffarpur and Darbhanga in that respect as regards rainfall and the necessity of water?—Yes, but not very much. If it was cultivated, it would be much the same.

82. *Q.* We understand that in Muzaffarpur and Darbhanga the water is not wanted more than once in four years?—They would want it more in Champaran. Northern Muzaffarpur and Northern Darbhanga do not depend entirely on the rainfall. They get an enormous amount from floods and the overspill of the rivers. We have not had famine or scarcity there when, according to the rainfall, we ought to have had one or the other.

83. Q. You would say that Champaran is more liable to scarcity than Darbhanga and Northern Muzaffarpur?—It is less protected by spill water, but the population is so small that they generally get enough to live on.

84. Q. According to the map there is quite as much distressed area in Darbhanga as in Champaran. There is hardly any dark-red area in Champaran?—It depends on the percentage of population relieved.

85. *Q* What I want is to get at the grounds for the belief that water will be taken there and not taken lower down?—They are not provided for at present in Champaran; the rainfall is not sufficient there, and is fairly sufficient in the other two districts. I do not think the spill water in Champaran counts as much for the district as in the north of Muzaffarpur and Darbhanga.

86. *Q.* The large schemes for Muzaffarpur are not then very promising?—No.

87. *Q.* Would it not be advisable to ask that the feasibility taking the Tribeni even further should be considered?—You cannot cross the Bagmati with the Tribeni Canal.

88. *Q.* (*Sir Thomas Higham.*)—It would be an unnecessary expense. If you go into the Bagmati, you will have to put up a weir; and if you make a weir, you can get enough water from the Bagmati itself. We must draw a line somewhere. I think it would be well to go up to the Bagmati. It looks as if the area to be protected by irrigation in Muzaffarpur is small?—By any big scheme, yes.

89. *Q* Do you think small schemes could cover a considerable percentage of the area?—What I should like to know is whether the water can be brought into the *chaurs* earlier in the year in anticipation of a possible failure of the rains. Take the Baya river. The spills from the Gandak river filled all the *chaurs* and these gave off their supply to the Baya all through the year. The planters agreed it would be good to close the old breach and put a sluice in, and now they are of opinion that they have made a mistake; their money has not only been lost but mischievously spent. Let these schemes be looked into and see if we cannot do something to secure water being brought in earlier in the year in case there may be a failure in that year.

90. *Q.* (*Mr. Muir-Mackenzie.*)—And something similar might be done in Darbhanga?—A good deal in the sadr sub-division especially.

91. *Q* All these schemes seem to me to protect areas outside the sadr sub-division of Darbhanga in which there was most distress?—There is an enormous area of *chaur* sadr sub-dvision that was very dry.

92. *Q.* You hope that you might be helped by some such scheme as you suggest?—Yes, by letting the water in the *chaurs* earlier in the year when the rivers are high.

93. *Q* If water was put into the *chaurs* earlier in the year and you had heavy rain afterwards, would the country be seriously damaged?—Not seriously, but there would be some injury. I do not look upon floods as a very serious injury on the whole. They are not very violent.

94. *Q.* Do you know the works which Mr. King constructed for the Maharaja in Darbhanga?—Not very well.

95. *Q.* You agree in the general opinion as to their great usefulness and efficiency?—I accept that.

96. *Q* Is there any chance of the material extension of well irrigation in these three districts of Champaran, Muzaffarpur and Darbhanga?—It is difficult to say.

97. *Q* Why is it not more extended than it is at present?—The poverty of the rayat and his unwillingness to incur a risk.

98. *Q* There is no unsuitability of soil?—Not generally. It is not much good a man having a well if he has no labour to work it.

99. *Q.* You do not think there is room for covering the country with as many wells as the best part of Saran has?—No. The soil is more suitable in Saran and there is more labour there.

100. *Q.* Investigation is wanted?—Yes, distinctly.

101. *Q.* It would be a mistake to abandon hope of extended well irrigation without going more into the subject?—Yes.

102. *Q.* As to advances for land improvement, you actually gave bounties for *kachcha* wells during this famine? Yes, about a rupee a well; they cost about two rupees. They covered a good area in Sitamarhi, but not much elsewhere.

103. *Q.* Would you give bounties for the construction of *pakka* wells in ordinary times? That has been seriously put before us?—I would if it were proved that they would be very useful in a particular part.

104. *Q.* The Opium Department apparently advance money without interest. Would you go so far as that?—I would not mind going so far as that if the survey showed that it was desirable as a good field for extension.

105. *Q.* Are you satisfied with the present system for the distribution of advances?—The Collector could do a good deal more if he knew his ground; if he were satisfied that it would be a good thing to make a well in a particular place, I should always be cautious of pushing an improvement unless I was sure it would be a good investment for the man himself.

106. *Q.* But supposing the Collector wished to push advances, could he not do it more effectively with a change in the system?—I think the present system serves well enough. There is no doubt a little obstruction, but it is very easily got over. The rayat won't take Land Improvement money; he will Agricultural Loans money. If he is going to give Rs. 200 for a well, he must be a substantial man; that is, practically a zamindar.

107. *Q.* Would he not take advances for improvements if the loan were spread over a longer period?—That would mean continual responsibility, but it would be a help certainly. It is not so much the system that is at fault; it is the number of small men.

108. *Q.* In Bombay and in Madras not only the Sub-divisional Officers but the Tahsildars are empowered to grant advances?—I think they might be given power to make inquiries, but they should get the order of the Collector before making payment.

109. *Q.* Is it necessary to have the Collector's sanction? You would lose a lot of money if you did not.

110. *Q* In Bombay we have not lost the money. I do not say that it has not been used for other purposes. As a general rule, it is recovered without any sort of difficulty?—In the famine we gave a remission of one-third for land improvement works, and there was very little taken—under half a lakh.

111. *Q.* Very much larger remissions were made in Bombay Presidency. There and in Madras remission of a half was promised in many cases. Could not the power go lower—to the Sub-Deputy Collector?—He is generally in charge of the treasury. We have only two men in the sub-division—the Sub-divisional Officer and the Sub-Deputy Collector. We could put on a *kanungo.* We used to accept his report in the famine and he gave the money out at once. But the real difficulty is the want of substantial men willing to incur the responsibility of taking an advance.

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112. *Q.* The Opium Department succeeded in getting rid of a certain amount of advances for wells?—Not a very large amount.

113. *Q.* Still it is larger than has been done outside the department; is it not?—Yes.

114. *Q.* The Opium Department have adopted the principle of getting the poor people to combine. Could not you do the same?—It would be possible, but very difficult. In the case of the opium advances they are probably all taken by opium men, and it is taken eventually out of the opium payments; and the man at the head of a gang has a good of control over it. They are all practically combined in the opium business.

115. *Q.* In the southern part of the Bombay Presidency all these things were said, but there happened to come a Collector who took up the subject very much in earnest, and the advances immediately increased enormously; and in Coimbatore, Madras, the same thing happened; it is difficult not to hope that something more may be done by individual initiative. We got up from a few thousands a year to over a lakh?—Yes, I think a lakh could soon be got rid of here.

116. *Q.* (*Mr. Rajaratna Mudaliar.*)—Does the fear of enhancement of assessment by the zamindar deter them?—No. Besides the man who took it here would be nearly always more or less a zamindar. I do not think the tenant would be afraid of enhancement where there is a record-of-rights.

117. *Q.* Where there is no record the fear does exist, I suppose?—I think so.

118. *Q.* In preparing your famine relief programme were you not guided by the circular of the Government of India, saying that you should provide for relief for 20 per cent. of the population for three months?—In preparing our famine programme we put down every work we knew of that could be of any use, and if it came to a bigger list than was actually required, so much the better.

119. *Q.* In 1896-97 over 36¾ lakhs were spent in Darbhanga district on famine relief. Could you kindly tell us what portion of it was spent on irrigation works?—I could not; but I should say extremely little—next to nothing.

120. *Q.* Is the condition of the *pains* generally so bad as to call for legislation to enforce upon the zamindar the duty of maintaining them in proper order?—Not generally. It is not so much that. It is the breaking up of the estate. It is more and more difficult to get them all to agree. One man stands out and blocks the improvement.

121. *Q.* So legislation is now more necessary than it was formerly?—It is growing more necessary, but not urgently necessary.

122. *Q.* (*Mr. Muir Mackenzie.*)—Mr. Oldham seemed to consider it urgently necessary in Gya?—I agree as to its desirability, but I do not think that the question is so pressing as Mr. Oldham says. Mr. Oldham, however, knows more than I do about that district.

123. *Q.* (*Mr. Rajaratna Mudaliar.*) Does the zamindar levy contribution from the tenants towards the maintenance of these *pains* or *ahars* in Darbhanga?—No.

124. *Q.* Where a *pain* is constructed by a zamindar at his cost, if the cost of maintenance is thrown on him, would you not let him levy a cess to cover the maintenance charges?—I do not think it necessary.

125. *Q.* Do you think that the introduction of differential water-rates would be useful; that is, with reference to the facilities for water-supply and the suitability of the soil for irrigation?—Some lands in the lower reaches would not get the full benefit of irrigation, and uniform rate of cess will fall more heavily in one place than another?—It is theoretically sound enough, but it depends on the nature of the scheme.

126. *Q.* Will you not be able to realize a higher revenue if you adopt a system of differential rates?—No doubt, if you press for it in places where the water is very much wanted. I do not see why you should not charge as much as they will pay.

127. *Q.* In Madras and Bombay we have consolidated assessments ranging from three to twelve rupees. There we differentiate between the quantity supplied and the quality of the soil. Under a system of uniform water-rate that is not possible?—Where you have a consolidated assessment, it is quite sound to make differences. But if you are simply charging for water supplied, you must charge the same price.

128. *Q.* Say a canal is 10 miles long. Why should not you have a higher rate at the upper 5 miles and a lower rate at the lower 5 miles to get a larger revenue and make the incidence fair?—In the Sone Canal system you might charge more in certain areas where it might be borne, but I do not think there is any necessity for it.

129. *Q.* (*Mr. Muir-Mackenzie.*)—The rate for the Sone Canal could, without any impropriety, be raised?—I think you ought to recover your expenditure, and if it be necessary, to raise the rate to do so. It would be fair to raise it, but I should like to see it kept as low as possible. I do not think you should charge all you can get. I should raise the rate very gradually up to the real value of the water.

130. *Q.* (*Mr. Rajaratna Mudaliar.*)—Do you think that any economy could be effected by entrusting the work of measuring and assessing and collecting to one and the same staff?—I have not had enough detailed experience to say.

131. *Q.* Do you see any serious objection to such an arrangement. The cost of the collecting staff comes to 5¼ annas per acre?—I don't think you could make any large reduction.

132. *Q.* (*Mr. Allen.*)—Your records-of-rights of water would include the record of any rights that might exist as to using the *pain* on particular days?

That would be one thing; and the length of time a *bund* is allowed to stand should also be recorded.

133. *Q.* If a water cess were imposed in the Saran district, would you exclude any lands which would not in ordinary years be benefited or those which would never be benefited by irrigation through those canals?—It would depend on the scheme. If any very large area was not benefited, I should exclude it.

134. *Q.* In this district, where there are schemes for irrigating a strip on the north side, do you think anything like a water cess can be imposed?—I would put it on the local area, something like the Drainage Act cess, except that I would leave out the provision in that Act under which you must get a majority of the people to agree. Let the Government lay it down; we shall get nothing done if payment is entirely optional. We are justified in compelling a tract of country to protect itself.

135. *Q.* You would have a compulsory levy instead of an optional charge?—Yes.

136. *Q.* In preference to a water-rate?—Yes. The expense of such a scheme would be small compared with the expense of a scheme where you have a water-rate.

137. *Q.* Would you impose a water-rate for water actually used as well as a cess?—I would make three stages—one where the scheme affected the whole district, one where it was carried over a very limited area, and one where it was in the nature of a complete system like the Sone Canal system. In the second case I would charge a small cess every year on the ground covered and also for the water. The water-rate would be the main thing, and I would hope gradually to drop the cess.

138. *Q.* With regard to Mr. Oldham's proposals for special legislation for disputes about water, would that be something supplementary to the Criminal Procedure Code?—Yes; whether there be a breach of the peace imminent or not he should have power to decide in cases of disputes or to take fiduciary possession of the works and to administer and maintain them

139. *Q.* Would it not be difficult to word a law of that kind?—It would be difficult. It is in accordance with what I proposed for Eastern Bengal. The zamindars entirely accepted the principle of that proposal. We have enormous *churs* there which they are always fighting over; they asked that the Collector should take possession of any disputed *chur* and, if necessary, manage it until he had decided who was entitled to it. A *chur* is an island thrown up in the river and new alluvial accretions.

140. *Q.* With regard to the two Loans Acts, the Board's rules for the Land Improvements Loans Act do not authorise the Collector to delegate his power for distribution of loans to a Sub-divisional Officer. Do you think that such a rule would be useful?—I do not think that there would be very much use in it. To us Rs. 200 is a large sum. At the same time there is no harm in the case going to the Collector for approval, the delay is not so great as to be serious.

141. *Q.* With regard to the Agricultural Loans Act, the preamble to the rules discourages the grant of loans under that Act except to very needy cultivators. Is that a useful preamble? Is that the right spirit in which the loans should be given?—I am afraid it is not. These loans are not of much use except in actual scarcity.

Mr. L. Hare.

142. *Q.* (*Mr. Muir-Mackenzie.*)—Would you think it advisable to begin with a cess within the Tribeni area?—No, it is not necessary.

143. *Q.* (*Sir Thomas Higham.*)—About your proposed cess I understand you propose that, in any district in which the demand is very irregular and where water is only required, perhaps once in four or five years, a cess shall be charged on all the area protected in addition to whatever charge may be made in the form of a water-rate?—Yes. If you have a complete canal system in which you can determine to what place the water can go.

144. *Q.* That cess would be leviable only on that particular tract that can be entered by the canal?—Yes.

145. *Q.* You say you would levy direct from occupiers along with the demands for water supplied in the same manner in which the present canal dues are levied. If it is a year in which they take water, you would levy the water-rate?—No, I would charge them for the water supplied, and they would pay their cess too. It would be fixed on a five years' calculation.

146. *Q.* The water-rate would be paid by the occupier?—Yes

147. *Q.* He would pay his water-rate if he took water and a certain charge on the area protected?—Yes.

148. *Q.* (*Mr. Muir-Mackenzie.*)—Would he also pay the cess?—I would call it an insurance fee.

149. *Q.* Do you wish both to be paid by the occupier?—Yes. In the case of a complete canal system.

150. *Q.* I understood the cess was to be paid by the zamindar?—Where you have a general cess, as I would in the Saran district, you will have to take it from the zamindar.

151. *Q.* (*Mr. Allen.*)—In the case of a complete canal system would you collect your cess from every rayat?—Yes, on the basis of the canal papers—simply a compulsory permanent lease.

152. *Q.* (*Sir Thomas Higham.*)—The cess to be so regulated as to give reasonable interest to cover the cost of maintenance. You would not call 4 per cent. unreasonable interest?—I should like you to put it lower probably, but I should like to be told the scheme and the probable benefit.

153. *Q.* Even when that demand is assured as on the Sone, there is very little prospect of touching 4 cent. I do not see how we can get it on a system where the demand is very irregular. But "reasonable" might be anything you like?—In Saran it was proposed to put a cess on the whole district like the present road cess and to have no water-rates at all and no charges for water. The general opinion is that it would be accepted.

154. *Q.* Would it be possible to put on a cess like that as part of the embankment cess?—You would have to amend the Embankment Act. You must legislate, because we have just made a twenty years' agreement for this embankment.

155. *Q.* The embankment cess is payable by the zamindars only? Yes, a percentage on the land revenue. The road cess is a percentage on the rent receipts of the estate.

156. *Q.* If you made these canals and put on an irrigation cess, would that be chargeable on the revenue or on the rental?—On the rental.

157. *Q.* That is to say, half would be recoverable from the landlord and half from the cultivator. For that you would require a special Act?—Yes.

158. *Q.* That would involve control by the District Board?—Not necessarily. You can put the control under anybody you like, but I think that the Board might take it up. In any case the man on the spot must have ample power and not have to refer to anybody. The District Engineer has great local knowledge and covers the ground.

159. *Q.* (*The President.*)—We should be glad to know if you have any suggestions you can give us?—I should strongly urge that Government should supply us a man to each district, but principally in the northern districts, to make a first or preliminary examination into all possible schemes that may be put forward and to prepare detailed estimates for promising schemes. We could then say that such and such schemes are so beneficial that we should be justified in legislating to secure the money to enable them to be carried out. I do not in the least expect that Government should incur all the cost, but I think it must give help.

160. *Q.* (*Mr. Muir-Mackenzie.*)—Who would decide as to the value of the schemes—the Collector or the Government?—The professional expert of the Government. In many cases, where it would not be justifiable to levy a cess, the schemes might be held over to be taken up in a famine. In Bhabua there are many works of that sort that could be done, opening cuts into *chaurs* from the rivers to secure the water when floods come, etc.

Mr. F. A. Slacke, Officiating Commissioner of Chota Nagpur.

(*Purulia, 3rd November 1902.*)

Mr. F. A. Slacke.

1. *Q.* (*The President.*)—How long have you known this district?—I have been here 8½ months, but I was Settlement Officer 16 years ago for 3½ years for administered estates in each district.

2. *Q.* Mr. Maconchy in his report quotes from your predecessor, Mr. Forbes, dated October 10th, 1901. On page 197 he says—"My own opinion, stated generally, is that Government would not be justified in undertaking any of these schemes, or indeed any other irrigation scheme in Chota Nagpur." And he repeats that rather strongly. Do you generally agree with him?—To some extent. No irrigation scheme would pay unless the present law is changed. Great difficulty is experienced in Government estates as regards the maintenance of he *bunds* made with Government money. In Palamau especially there are 1,200 of these *bunds* which are never regularly kept in order, because it is not the interest of the rayats to keep them up. There was no proper local supervision, but this is now being organized, and it is hoped that the *bunds* will then be looked after. If you make it the interest of the rayats to do so by making it illegal to enhance a man's rent on the ground of such improvement, it would be a good thing for the Government to assist the rayats generally. But until the law is changed it would be a waste of money.

3. *Q.* Is that what you refer to in answer to question No. 7 "with regard to the nature of the tenancy the existing doubts will, in the course of the next few years, be removed"?—Yes. The rayats know that if they make an *ahar*, the landlord will certainly enhance upon the improvement. Consequently they won't do it.

4. *Q.* Is there any likelihood of legislation being affected?—I think so. At present there is a bill to amend the present Land Tenure Act, and it is to be passed into law this cold weather. I hope that is only a preliminary. A survey and record-of-rights is being made in parts of Ranchi, and from the information which will thereby be obtained the existing Act will be cancelled and a new one brought in which I hope will remove difficulties.

5. *Q* The landlord is not to be allowed to enhance?—No. The Bengal Tenancy Act prevents that with regard to improvements made by rayats for all time. In this part it may be prevented for a certain time only. The principle is the same with a modification. Here you have the *kerker* system which has been very successful. The terracing of the fields here has been done entirely by the rayats, the landlords have never by terracing it. The field so made is called a *kerker* or *khundwat* or *ariab* field. The maker holds the field so made at a privileged rate of rent for a length of time which varies in different parts. Sometimes it is for end and sometimes for a definite period. It would be better to apply this recognized principle to *ahars* made by rayats than to introduce the Bengal system. The whole country has thus been terraced and the same result would happen with regard to *ahars* if the same security existed.

6. *Q.* Do you refer to that in answer to question 10—"I would suggest that after the expiry of the period, for which the land improved may be held subject to no additional rent, the tenant may be called upon to pay enhanced rent; the new rental, however, not to exceed what the rental of the land would be at the rates next, but one below those prevailing for lands of the same quality in the village"?—Yes.

7. *Q.* Apparently the zamindar will not borrow money to improve his estate?—Where he has the inclination to improve his estate he does not have the money. He knows that if he borrows the money, it has to be distributed by his servants and not half of it will be spent on the land. He never goes to see his lands. I only know of one landlord in the whole division, who is really keen about improvements. Some won't allow the rayats to make any improve-

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ments themselves. The landlords here are always more or less in debt and periodically have to apply to be brought under the Encumbered Estates Act. The Wards and Government Estates and Encumbered Estates cover, roughly speaking, a third of the whole of this division.

8. *Q.* Some of them, I understand, are permanently in the hands of Government. It is not merely that the landlord is in debt?—There are very large Government Estates.

9. *Q.* Are they held on a rayatwari tenure?—Almost all. Until quite recently a very large Government estate in Palamau was let out to *thikadars* ever since the original settlement, but under the new settlement of 1897 it has been made rayatwari.

10. *Q.* Is there anything to prevent the tenants availing themselves of the Land Improvements Acts and putting their works in order?—They always have the fear of having their rents enhanced.

11. *Q.* Even by Government?—It has never been said that it should not be. The law allows it. The villages might be put under *thikadars* again. Then the *thikadars* would come in and enhance the rents.

12. *Q.* You think there is nothing for it but this tenant right?—Some system to make it the interest of the rayat to make the *bunds* and keep them in order is needed. I have seen cases where to get fish the *bunds* have been cut by the rayats and then patched with a little mud with the result that the *bunds* went the next season. It is not to their interest to repair them properly.

13. *Q.* It is really the fear of enhancement and not apathy?—That they will work for their own interest is shown by their terracing. Think of the crores of rupees represented by that labour. It is all done by them, because they get a return for their money.

14. *Q.* In the old days had they a security they have not now?—They had security for terracing lands which they still have. No landlord would think of infringing that.

15. *Q.* Are these terraced lands in a better position than the *bunds*?—Yes. The bulk of a zamindar's rental is from the rice lands, and therefore the fewer rice lands a zamindar has the less his rental. Consequently he has a keen interest in inducing the rayats to increase the area of the rice lands.

16. *Q.* In reply to question 9 you say—"In all probability there will be many cases in which a tenant, desirous of making an *ahar*, cannot do so, as some land necessary for the scheme is not in his possession." Mr. Horn says they do have a method on the Sone Canals. To secure land for village channels paid for by the villagers on the Sone Canals they have a procedure by which the land is acquired by the land acquisition officer and 10 per cent. is charged for establishment charges?—That would be much too expensive and much too lengthy. Some simple system is wanted such as that in force in the Kolhan. The headman of the village refers the matter to the Deputy Commissioner, and if it is waste land it is given, and if it is somebody else's land it is valued. The rayat who wants to make the *bund* pays the value assessed for the land required unless the Deputy Commissioner is able to give the man ousted some equally valuable land elsewhere. It works very well.

17. *Q.* On what authority is it done?—Under the record-of-rights.

18. *Q.* Is it desirable to have legislation compelling the landlord to keep his *ahars* in order? No. How are you to enforce it? You would have to leave an immense staff to go round to see that these *bunds* are being kept in order, and that staff would probably blackmail right and left and certainly live at the expense of the rayats. To have a working system you must make it to the interest of the rayat to keep the works in order.

19. *Q.* Our last witness suggested that there should be a cess on the land, and that the District Board or the District Engineer should do the whole of the repairs?—He has all he can do now.

20. *Q.* You might employ another?—How can one man look after all these *bunds* for a district like this, or for 6,000 square miles in Hazaribagh, 7,000 in Ranchi. Then, if you increase your men, your funds will be absorbed in salaries, and besides there would be the delay and the blackmailing by the lower subordinates.

21. *Q.* You have sent in a paper by Mr. Thomson, Deputy Commissioner of Singhbhum, and he mentions the Kolhan Estate "for improvement of which Government allots about Rs. 10,000 annually, out of which about ⅓ or ¼ is annually spent for making *bunds* for irrigation." Does that estate pay?—Yes. But there is no recognised working programme. It is simply a case of from hand to mouth. If a man wants a *bund* and there is no money, it is put off till the next year. I want to have some definite working plan showing for each village how many *bunds* are wanted.

22. *Q.* Will that require an officer especially for the purpose?—No, the Tahsildars can work it out by degrees.

23. *Q.* Is a Tahsildar capable?—There are small *bunds* for irrigating from one acre to about fifty acres.

24. *Q.* We have had a few projects put before us on a bigger scale altogether. Do you believe in them?—I have only seen one, the Pakrahar. I certainly think that one might be tried. The Nadowa possibly. Let one be tried in order to show whether this opinion is correct or not. It is founded a great deal upon hearsay among the people. Consequently some authorities say one thing and some another. The people certainly do believe that if such works were, they would be of very great assistance, and if one were carried out, we should have something to point to. We want some system of utilising the water running away in these nullahs to fill up the *ahars* in years of drought. As to whether there is any place where a big lake can be made, there is one, I am told, on the confines of Singhbhum and Ranchi, in which a very large amount of water would be stored up. It is a big valley, fed by mountain streams, and has a very narrow opening, which would be embanked, and then by means of a channel the whole plain below could be irrigated. The channel would, however, have to be about 7 miles long. The information was given me by a missionary at Chaibassa. It would irrigate a part of Singhbhum north of the railway line and near Chakardharpur.

25. *Q.* Do you think that is worth investigating?—Possibly. I was told there was a great waste of natural material there.

26. *Q.* Is it a part of the country where they would be glad to have irrigation?—Yes.

27. *Q.* (*Mr. Horn.*)—You would want a big dam? I am told the opening is only 300 yards long.

28. *Q.* (*The President.*)—Is there any scope for the extension of well irrigation?—None.

29. *Q.* Why not; because of the rocky soil?—Yes; to make a permanent well is very expensive. Well cultivation is used only for lands just round the peoples' houses and they do not value that cultivation so much as the rice.

30. *Q.* On the other hand, a well would not fail then in time of drought?—Wells always fail at the beginning of April. My own go very deep, but I had to get water from a lake. In Hazaribagh this last hot weather the whole town drew its water from one tank and one well; all the rest had gone dry. One class which does use wells is the Koeries, the professional market gardeners, but they are much more advanced cultivators than these people.

31. *Q.* Are the people industrious?—They will work hard for themselves, but not for anybody else. Drink is the great curse amongst them. They complain that we put too many obstructions to their getting drink The *Kols* are the people I refer to.

32. *Q.* (*Sir Thomas Higham.*)—You are not very much in favour of making these small projects that have been examined. Have you any preference?—No; but I would favour one that did not cost much. One costs 3½ lakhs, I believe; I would not take that. One costs Rs. 70,000; I would take that up. I would like to take up a scheme in Palamau where five projects have been proposed.

33. *Q.* All these schemes irrigate a great deal of Government land, and the return for them would be looked for eventually in increased rentals?—Plus the less need of cost for famine.

34. *Q.* How long would you have to wait for the increased rent?—The rayats would agree to pay at once with regard to lands already under rice cultivation and which were improved by the work. But with regard to other lands which had to be terraced or otherwise rendered fit for rice cultivation, a certain period would have to be given before the enhanced rent could be demanded. It would depend whether Revenue might say, as they have already said, that it is not advisable to take an increase of rental during the currency of a settlement. They would, I understand, postpone carrying out these schemes until the present settlement has expired.

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35. *Q*. That is, in 1911?—About that. They have never expressed any opinion adverse to these schemes themselves, simply as to the time of carryng them out. The Board have been told that the people are willing to pay now.

36. *Q*. What is the Board's objection? Do they think that if they wait till the end of the settlement, they could raise the rents to a greater extent?—No. It does not please them. A settlement has been made and the rentals fixed, and hence it does not seem right to the Board for 15 years to step in now and raise the settled rent, because of improvements made during the currency of the settlement.

37. *Q*. Would it not be a good thing to carry the schemes out at once even if the rents were not raised, for, when the time comes for raising them, you will have had a little experience to go on as to the value of the works?—I should say, carry out one, whether you raise the rental or not.

38. *Q*. You do not think you can raise the rental directly you have constructed a work before you know what it is going to do? You might put it up to more than the rayats could pay?—I would not take the increased rent from the rayats until it was shown to be of some benefit. The inquires would not take long. These small schemes do not irrigate such large expanses of country.

39. Q. What about land of which Government is not the landlord?—I understand the zamindars would contribute part of the cost.

40. *Q*. Would they?—They say so.

41. *Q*. In the form of taking a loan for it? A part of the cost would be debited to them?—Possibly. It depends on whether the man is impecunious or not.

42. *Q*. There would be no question of a water-rate in that case. They would be entitled to their share of the water in consideration of the contribution they made?—Yes.

43. *Q*. You think the main thing in this district is to increase the number of *ahars* through the tenants?—Yes.

44. *Q*. The inducement to the tenants would be that their rent would not be raised—for how long?—It all depends on the amount of work the man has done and whether you adopt the principle of the rest of Bengal or that which holds locally in the case of *kerkcr*.

45. *Q*. You propose that at the expiry of the period, for which the land may be held subject to no additional rent, the tenants may be called on to pay an increase of rent?—Because that is in conformity with the existing system of terraced lands.

46. *Q*. He would pay a less rent than the rayat would who had not made the lands, who succeeded to somebody else's labour. Would that be a sufficient inducement?—Yes, as you see by the crores of rupees represented by the terraced lands in these parts.

47. *Q*. Would you give them some right and privileges to make *ahars*?—Yes, I would give them some vested interest in making these *ahars*.

48. *Q*. Have they not such rights?—Not that I am aware of. They run the danger of having their rents enhanced.

49. *Q*. If they had these rights, would they make them?—I don't say you would have the country covered with *ahars* at once. It takes a long time to get ideas to sink into their heads and to realize a change.

50. *Q*. You think they are really prevented?—I think so.

51. *Q*. They want some pecuniary assistance?—They have found money of their own to make these terraced rice fields. There are no loans for this.

52. *Q*. You don't think they will depend on Government for loans?—I don't think so to any great extent. If they have been able to work these fields without loans, why should they not make petty *bunds*, etc., without loans.

53. *Q*. Have you started anything in the way of agricultural banks?—They are just beginning. I cannot say anything definite about them. There has not been time enough to judge of them yet. They have advanced out the money that has been lent to them, but the time has not yet come for the repayment of the first instalment.

54. *Q* They have advanced money for improvements?—It is supposed to be for improvements.

55. *Q*. How long have they been started?—Some have been started in May and some in June.

56. *Q*. Who manage them?—The people themselves.

57. Q. The landlords?—The headmen of the villages; the leading rayats of the villages.

58. *Q*. You have got them in every district?—No. We have not got them in Singhbhum; we could not have them there; the people are too illiterate. We have got some in Ranchi and some in Hazaribagh; these are all that I can remember. I don't think there is one here (Purulia).

59. *Q*. (*Mr. Muir-Mackenzie.*)—If I understand you correctly, Mr. Slacke, you think the zamindars are not likely to make these improvements—not anywhere, not in any district?—Yes. You may find an individual like the zamindar of Untari doing so, but there will not be many others.

60. *Q*. You mean not generally, not for instance in Palamau?—Well, the Raja of Chainpur may carry out some; he is a good landlord.

61. *Q*. I understood Mr. Lyall to take a more hopeful view. He seemed to think that the zamindars, if they were able to raise their rents, would see the advantage of making these improvements?—Why have not they done it before? Instead of this they are running into debt. One can only say the proof of the pudding is in the eating of it. There is the fact that at present you have two of Mr. Lyall's most influential zamindars who are likely to have their estates brought under the Encumbered Estates Act too. They are all reckless—at least the bulk of them.

62. *Q*. Mr. Lyall's view seemed to be that if they got advances given to them by Government, they would easily take the money?—They would take them.

63. *Q*. And would spend it on improvements, because they would be immediately recouped, sometimes getting as much as 75 per cent. on it?—Then, if a man could do that, why not spend his money on these profitable improvements instead of recklessly getting into debt?

64. *Q*. He understands it is remunerative. In one of the Court of Wards Estates, in which they spent Rs. 11,000 on improvements, they raised the rental from Rs. 13,000 to Rs. 25,000?—I have not got the figures. These improvements are very remunerative as I have mentioned. They are so remunerative that the Untari zamindar will not allow his rayats to carry out any improvements. He makes them all himself.

65. *Q*. (*The President.*) There might be a respectable zamindar who succeeds to an Encumbered Estate?—It is quite possible, but there are very few such cases.

66. *Q*. (*Mr. Muir-Mackenzie.*)—There are considerable areas under Government Estates?—Very large.

67. *Q*. Are you at all satisfied with the amount done on them?—No.

68. *Q*. Do you consider that all that could be done has been done?—By the rayats?

69. *Q*. By Government with the object of increasing its rental?—It has spent money and enhanced its rental in consequence.

70. *Q*. I understand you to say there are only small improvements?—Because they are only small works. You put up a *bund* by which five acres of land are irrigated and an increased rental obtained. Government does this. But the difficulty comes in with regard to the maintenance of these *bunds*, which the people themselves will not do.

71. *Q*. On account of the difficulty of maintenance you don't think considerable profit would be made?—I would rather have the people do it themselves and keep the profit to themselves. The more underlings you have going about in an estate, the worse it is for that estate. We are about to introduce a system into the Government Palamau Estate by which the headman in each village will get a little piece of land in return for which he must, among other duties, look after these *bunds*. Of course I cannot yet say whether it will succeed or not.

72. *Q*. So that even in Government estates you would infinitely prefer to see improvements in *ahars* made by the tenants themselves?—Yes.

73. *Q*. You seem to me to prefer a temporary exemption from advancing the tenants' rent to the permanent exemption as being more in accordance with the custom of the country?—Yes.

74. *Q*. Are you quite clear that would be a sufficient inducement?—Yes, because of the example of the terraced lands here.

75. Q. How far at present have the tenants in Chota Nagpur got occupancy rights?—It depends on the will of the landlord, but they have got it under the law. If a man can prove he has been continuously paying rent for a certain bit of land, he has

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got the right of occupancy in it. They do not know their rights and it is difficult to prove them. If it comes to a survey and you make a record-of-rights, you will find that the bulk of them really have occupancy rights.

76 *Q.* Has there been any record-of-rights made for the Government estates?—Yes.

77. *Q.* Have they got their occupancy rights in those estates?—Yes. The Government never ejects their tenants like private zamindars do.

78. *Q.* They are liable on the Government estates to enhancement of rent at the conclusion of settlements like other occupancy rayats?—They would even in Bengal under certain conditions be liable for enhancement of rent.

79. *Q.* Is there any danger of those *ahars* proving useless in a famine year by being exhausted?—Yes.

80. *Q.* The evidence on that point seems to me to be a little conflicting. The last two witnesses have been most emphatic in declaring that they will hold water in a bad *hathia?*—If the water is there, they can hold it; but in a bad year unless there is some source to replenish them, they would not.

81. *Q.* That is to say, they must be connected with some streams?—Yes.

82. *Q.* Is it not likely that, if the *ahars* are in good condition and are not blocked with silt, there would be sufficient rain to fill them?—Yes, but then a great deal depends upon the time when the rain falls. It might fall in a suitable month and then it would be all right, and it might fall in a non-suitable month and then the *ahars* would be dried up.

83. *Q.* Say you had 20 inches of rain up to the middle of August and none after that, would the *ahars* be empty?—No, I do not think they would, but I do not say they would be full; there would be a certain amount of water in them. But if your rain fell heavily in July, and you had merely scanty showers in August, then "no."

84. *Q.* You have pointed out how the advances, if made to the zamindars, would be misappropriated. Do you think there would be no similar danger if they were advanced to the tenants?—Of course there would be in some cases, but the amount which would be asked for advances would be very little. The rayats do not like taking advances from Government, because of the conditions under which the sums are realized. If the system were improved, then you might have more demands

85. *Q.* With that change of system would you be able to dispose of any considerable sum?—I think so

86. *Q.* How much do you think you could dispose of in your division?—I should think we could dispose of four lakhs a year easily. The needs of Bengal are never met by the Government of India. I think I am right in saying that the amounts asked for by the Government of Bengal are never granted by the Government of India.

87. *Q.* (*Mr. Rajaratna Mudaliar.*)—Would you like to see the rate of interest reduced from 6¼ per cent. to 5 per cent. as in Madras, and the period for repayment extended from 20 to 30 years? Would that afford a greater stimulus?—I think not, because the 6¼ per cent. is so very little as compared to what they pay their native mahajans here, and then 20 years seem to me quite long enough. If you have a proper system of distribution and realisation, I think 20 years and 6¼ per cent. is fair enough.

88. *Q.* As regards the system of distribution, would you employ officers of the standing of Deputy Collectors?—I would employ gazetted officers of the lowest grade to go out locally.

89. *Q.* What does Government pay for the money?—1 per cent.

90. *Q.* Then the difference between 6¼ per cent. and 4 per cent. ought to cover the cost of any additional establishment that may be employed?—Then you have to meet losses. If the crops fail and the men run away, there is nothing to be realised from them and the amount has to be struck off. I have never seen any balance sheet struck, but I do not think it is a paying business to Government After you take your 4 per cent away, then I think Government loses.

91 *Q* Then, as regards realisation, what are the best means? You have no village agency for that?—Yes, in several of the districts here, we have a village agency for that. We have a recognised headman in some places; he is called a *moonda* and in other places he is called a *manki.* He is the recognised headman of the village, and you can work through him.

92. *Q.* You said you would prefer to see *ahars* constructed by the tenants I suppose they will be able to construct *ahars* only in their own holdings. Where an *ahar* falls in another man's holding, are they likely to combine?—No. There is a want of combination among them.

93. *Q.* In such cases what is to be done? Government, I suppose, ought to step in in such cases?—If it were absolutely necessary, they would do so. In a country administered like the Sonthal Pergunnahs the Sub-divisional Officers call the principal men together and get them to combine and carry out this work.

94. *Q.* As regards the privileged rates of rent; that so far has acted as a stimulus in inducing the people to terrace their lands?—Yes.

95. *Q.* You proposed to extend that system to *ahars?*—Something analogous to that system.

96. *Q.* We have something similar in the Madras Presidency, but there a condition is attached that if the works are not maintained in proper order, the concession is liable to be withdrawn. Would you adopt that system here?—No. That implies that somebody should go round, which generally ends in eight annas or a rupee being taken and a lot of other evils. If it is not to a man's interest to do this, he goes away and the land is let to another person whose interest it will be to do so.

97. *Q.* The tenants here have no saleable interest?—No. Well, at present there is nothing against it, except that there is no mention made of the transfer or sale of ready holdings in the Chota Nagpur Landlord and Tenants' Act. Up till quite recently they have not had any right to sell their lands, but the practice is gradually and very slowly creeping in. In the amended Bill that will be introduced in the Council; I understand a provision will be introduced to prohibit the sale of rayati holdings altogether. Hitherto this practice has never been recognised by anybody, but by their contact with more highly advanced races the people are gradually coming to imbibe the idea that they have a right to sell their holdings, which is not good for them, because they are very thriftless and reckless

98. *Q.* Mr. Twiddell, in answer to question No. 10, says that "an irrigation cess like an embankment cess might be imposed to provide funds for the construction and maintenance of tanks and *pains*". Do you approve of that proposal?—No.

99. *Q.* (*Mr. Allen.*)—You know the Saran district well?—Yes.

100. *Q.* For how long?—2½ years.

101. *Q.* How long ago was that?—I left it in the middle of 1896.

102. *Q.* A good deal of evidence has been given before the Commission as to the advisability of improving what are known as the Saran Canals and recouping the expenditure involved by imposing a water cess on the district as a whole. What would be your opinion?—It would be quite unfair, because the bulk of the lands in Saran would never get any benefit from the water, and to assess them because of the improvements made in these canals would be quite unfair. The district is shaped like this (witness explained how the district was shaped on the map and also how it would be impossible for the lands he referred to getting a pice worth of benefit out of any improvements that would be made). Continuing witness said—You have spent seven lakhs of rupees on these canals and nothing has been done, and if you spend another seven or twelve lakhs, nothing will be done, and you will be spending good money after bad The year before last I was Revenue Secretary and the point came about the opening of these canals. The District Board, the Collector and the Commissioner wrote down to Government to pass orders to have these opened. Mr. Buckley was then Secretary to the Government in the Public Works Department. He drew up a very good note showing how much had been lost in the past; but then the pressure was too great and the order was passed to open them and then what was the result—4,000 acres only were irrigated.

103. *Q.* It was also suggested that the water level would rise and so wells in other parts of the district would benefit also?—That is very doubtful. If the water level rises, it would mean more malaria. If you have a water level very close to the top of the district, it means a malarious district

104. *Q.* (*Sir Thomas Higham*)—What is your opinion about these canals?—What do you think is wanted?—Nothing.

105. *Q.* (*The President.*)—The argument was that the silt clearance was not properly regulated and that the water when it was given came too late to be of any use, and that the canals only wanted to be put under proper agency?—If the people of the district believe that, why do not their own District Board take it up.

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106. *Q.* The District Board advocated it?—But they don't advocate the spending of their own money.

107. *Q.* (*Mr. Muir-Mackenzie.*)—They said the district would be willing to pay?—It has not been levied yet. Those men who said so were not speaking on behalf of the rayats. I don't think you would find that the rayats would agree to pay an extra cess.

108. *Q.* (*Sir Thomas Higham.*)—They send water down here (indicates on map); don't they?—It is not of much use. The people who get most benefit from this water here are the factories.

109. *Q.* A good many people get benefit from the factories, because the factories are alongside of that nullah?—Yes, there used to be factories. There are deserted factories along there now.

110. *Q.* (*The President.*)—But there was much absolute unanimity of opinion from the Commissioner downwards that this place would have its salvation worked out?—If they are so unanimous about it, they ought to urge the District Board to find the money required and look after the scheme. Then you will find they won't burden themselves with it.

111. *Q.* (*Mr. Allen.*)—About this Encumbered Estates Act you say about one-third of the division is under Government administration?—More than one-third. One-third is under the Encumbered Estates Act.

112. *Q.* Do you consider that sufficient money is spent on improvements in these estates?—No.

113. *Q.* What is done?—There is no working plan; no system whatever, and everything is subordinated to paying off debts; whereas under the law (section 4) improvements come before paying off debts.

114. *Q.* What do you think should be done?—I think myself that when a scheme is sent up to the Board for approval, it should be made subject to revision or report of the Collector or Deputy Commissioner when he knows the tract and is in a position to say how much is required for improvements. It is said in the Act that application shall not ordinarily be submitted by the Commissioner without the consent of the Lieutenant-Governor unless the debts can be liquidated in 15 years, and that "ordinarily" is generally not read, so that no scheme is sent up unless it is made out that the debts can be liquidated in 15 years. Therefore everything is subordinated to the liquidation of debts, whereas the law says the cost for improvements should come before the liquidation of debts. Therefore there should not be any great stress laid upon the length of time for which the estate should be retained under Government management, and the scheme should be accepted subject to the possibility of its being revised when the Deputy Commissioner knows actually the needs as regards improvements for that particular estate.

115. *Q.* (*Mr. Muir-Mackenzie.*)—I understood you to say that even on estates managed by Government you would prefer that the improvements should be made by the tenants?—Yes, if you can get it done by the tenants. You could not get it done now. For instance, as I said just now, there is a want of combination among the tenantry, and then of course you will have several cases in which the works are too big for them to carry out. If you choose to wait years and years, then the rayats themselves may do it; but if you don't care to do that, either Government must step forward in Government estates, or Government must take the place of the proprietor in carrying out the improvements in the encumbered estates. There was a case came up the other day of a very big *ahar*—an old one which had cost Rs. 4,000, and you could not get the rayats to combine to take the silt out of it unless you reduced their rents. Similarly, there are very many other *ahars* silted up, which you could not expect the rayats to attend to but the zamindars. I am having them included in the famine works programme, so that when any famine comes, they shall be taken up as famine works.

116. *Q.* Is it the case that a great number of estates in this division come at one time or another under the Encumbered Estates Act?—Yes, or under Government management. You have got 44 or 45 per cent. of this division now in Government hands, and there is another big estate coming in shortly that will increase it more. In this division ⅔ of the estates are in Government hands.

117. *Q.* If a more liberal policy is pursued in carrying out improvements in these encumbered estates, a great deal of good will be done?—Yes. As matters stand, the only good, as far as I can see, that is done by the Encumbered Estates Act, is to prevent the people coming into the hands of alien landlords and to pay off the creditors. There are many cases in which estates after being released have again been taken under the Act in a few years time. Proprietors during the time the estate is being managed surreptitiously borrow money at heavy interest and on the estate being released confirm all their engagements with the result that they are swamped and then apply again to Government to be taken back under the Act.

118. *Q.* (*The President.*)—This is a policy for the protection of insolvent landlords?—It saves the people mainly.

119. *Q.* (*Mr. Muir-Mackenzie.*)—On the Government estates if the enhanced rents are maintained, is it not surely the duty of Government to repair these estates?—That is now being done; efforts are now being made to keep them in repair, but it is not the duty of Government to repair rat-holes. If at present there is a rat-hole in a *bund,* the people do not try to close it and so by degrees it enlarges, and if nothing is done, it gets bigger and bigger till finally the *bund* is destroyed. The *mahto's* business will be to see that the rayats carry out at their own cost petty repairs like that. Big repairs will be done by Government.

120. *Q.* Is it not necessary for the *mahto* to have at his back any compulsory provision?—No. A man would not be appointed as *mahto* if he had not enough moral force or power behind him to command the rayats.

The Hon'ble Mr. W. C. Macpherson, Secretary, Government of Bengal, General and Revenue Department.

Mr. W. C. Macpherson.

(*Calcutta, 7th November 1902.*)

1. *Q.* (*The President.*)—You are Secretary to the Government of Bengal?—Yes, Officiating Revenue Secretary. I wish to say that I am in no way authorised to speak for the Bengal Government, and that I have not received previous notice of questions.

2. *Q.* What districts have you been in before?—I have been District Officer in Muzaffarpur, Nuddea, Rajshahi, Purnea and Saran, and I have visited most of the districts in the Province in connection with the land settlements of which I was in charge for five years. I had my longest district experience in Saran.

3. *Q.* Of the districts which you have named Saran and Muzaffarpur are the only ones that come within the range of famine?—I think all the five districts are down in the list of districts wholly or in part liable to famine, but Saran and Muzaffarpur are more especially liable and Muzaffarpur more than Saran.

4. *Q.* This is, I suppose, on the north side of Muzaffarpur?—The Sitamarhi Sub-division on the Nepal border is especially liable to famine.

5. *Q.* Were you long in Saran?—For over two years.

6. *Q.* I do not know whether you heard the evidence of Mr. Macgregor given this morning?—I heard some of Mr. Macgregor's evidence.

7. *Q.* It has been strongly represented to us by people in Saran, and we have heard two opposite sides of the question, that it would be just and equitable to lay a small cess for irrigation upon the district or a part of it. We took evidence at Muzaffarpur on this question and the opinion of those who came before us was that the cess could be fairly levied. Mr. Growse and Mr. Hare thought so. Since then we have heard Mr. Slacke, the Commissioner of Chota Nagpur, who pronounced very emphatically against it?—I would go rather with Mr. Slacke so far as I read his evidence in the newspapers. In Saran the people remember that an embankment cess is in force. A strong Collector, Sir Antony MacDonnell, imposed the embankment cess on every estate in the district. It is a small cess and there is a great deal to be said for the whole district bearing the burden of it, because if the whole of the district is not protected by the Gandak embankment, the greater portion is. So far as I know there has not been any complaint from the zamindars of any portion of Saran about the embankment cess that all do not derive benefit from the embankment; but in the case of an irrigation cess one would have to carefully consider who would benefit from the irrigation works. I do not think there is any precise estimate before the Government as to what the area is that would be irrigated by the so-called Saran Canals if they were extended and put in working order.

8. *Q.* I think the highest estimate we have got is 100,000 acres, and I imagine it is merely a matter of

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money to make more distributaries, for there is a plentiful supply of water from the river?—It has been stated that the largest area ever irrigated, in any year, from these canals in their unfinished state was 21,000 acres; and Mr. Buckley suggested a doubt whether water would be forthcoming when it was most wanted in the *sotas* of channels; that is, in October. I should say it would be unjust to make the whole of Saran pay for irrigation possibly covering 100,000 acres.

9. *Q.* Mr. Macgregor remarked this morning that one might draw a pretty clearly defined line between lands that would be benefited and those that would not. Do you think that would be possible; it would mean throwing the north-west portion outside the line?—It would no doubt be possible to say, if levels have been taken, that the irrigation would benefit such and such villages, but 100,000 acres is nothing compared to the area of the district; 2,300 square miles, or thereabouts.

10. *Q.* The argument brought before us was that the advantage to the district would be so great that no objecion would be raised. That is, if water can be brought into the canals. Mr. Macgregor's idea was that the whole of the country would be commanded. I told him that Mr. Ogilvy, Manager of Hatwa Estate, had recommended two more sluices, and Mr. Macgregor said that the whole of the district would be commanded and benefited and the cess would not be unjust. Of course the cess would be a very small one?—We have no precedent for such an irrigation cess in Bengal. When it was proposed to legislate about 25 years ago to impose a compulsory irrigation cess the Bill was dropped on the ground that the proper way for Government to recoup itself for such expenditure was to make a bargain with the people who took water.

11. *Q.* If one could be certain that water would be required every year, you could face the question of return from the water-rate from the area irrigated?—That is what we are not certain about. First of all, we want a scheme showing what can be done.

12. *Q.* Can you count upon people taking the water regularly?—It is extremely difficult to say. Our experience in Orissa shows that it is only slowly that the rayats have appreciated the insurance of the water. In Orissa the rayats for a long time were very slow to take the water. They trusted to the rains. The rains fails only occasionally, and they say the water is no good to us if we get the rain. I think it would be very dangerous to make such an assumption as I heard Mr. Macgregor make as to everybody rushing to take the water.

13. *Q.* If one can draw a comparison from the Sone irrigation, it rather goes the other way. The people of the Sone area are anxious to take water?—That part of South Bihar is much drier and thirstier than North Bihar.

14. *Q.* (*Mr. Muir-Mackenzie.*)—The rainfall of Saran and Shahabad does not seem to be very different if you take the Buxar and Chupra figures?—The districts are large. Shahabad is hotter than Saran and has a different soil.

15. *Q.* (*The President.*)—Have you any suggestions to make as to any reasonable course the Government might adopt to give irrigation to Saran without going to extravagance?—I think a survey is preliminary to anything. We want to know what the expenditure would be; what water can be got into the so-called canals; whether it can always be counted on in October, and what area could be commanded.

16. *Q.* You say Mr. Buckley thought water would be insufficient in the Gandak?—The suggestion is, I think *not* that the water in the Gandak would fail, but that water could not always be got into the *sotas* and channels in October. Then we want to know what area the water can be distributed over; what is commandable, the cost, and there is the question whether the rayats will take the water if the rate be a voluntary rate. All these are problematical; and it is possible that there may be difficulties in the slope and level of the country. I do not speak as an engineer. There is a general fall to the south-east; but it may be found that the existing canal beds are deep and below the level of many villages.

17. *Q.* I don't think the circumstances of the case are such that one could make a strong recommendation to the Government to carry out works which would not pay working expenses?—Saran is a three-harvest district, and it is more immune from famine than the other three districts of North Bihar because of the three harvests; also because the people emigrate largely; they leave the districts for work and bring back or remit to their families considerable sums earned as wages.

18. *Q.* The conclusion that our information appears to lead to is that we shall have to leave Saran severely alone?—I should be very sorry that the question should not be thoroughly threshed out as to what can be done and at what cost to improve the Saran Canals and what can be offered to the cultivators and at what rates.

19. *Q.* What proportion of irrigation in the district would justify a cess? If one could irrigate every year ½ or ¼ of the district, would it be justifiable?—No. I do not think that a general cess for such an amount of irrigation would be justifiable. We have no such cess or owner's rate for irrigation in Bengal, and I believe it has been abandoned in the Upper Provinces.

20. *Q.* (*The President to Sir Thomas Higham*).—Has the owner's rate been abandoned in the Punjab? Mr. Mackenzie says it has?—Yes.

(*Witness.*)—In Orissa we have got some return for the expenditure on irrigation by the increased land revenue, and we have just increased the water-rate paid by the occupiers from Rs. 1-8 to Rs. 1-12 an acre.

21. *Q.* (*The President.*)—Turning to the question of *takavi* advances, do you think that the system could be improved?—I think the system is capable of improvement.

22. *Q.* Do you think our system is too rigid?—The difficulties that occur to my mind are those that were mentioned by the Maharaja of Sonbarsa. The rayat has a difficulty in persuading the *hakim* that his as a proper case for an advance. Preliminary inquiries have to be made before an advance is given as to the security, and then too it often happens that the subordinate officer who makes the inquiries is corrupt.

23. *Q.* That has been the tendency of the evidence we have had elsewhere. Very often the thoroughly conscientious officers have been afraid to take the responsibility and there have been delays of months sometimes. We have been told more than once that if a Sub-divisional Officer was told off for the purpose and took about with him a bag of rupees, a great deal could be done?—That is an improvement of the *takavi* rules which the Bengal Government has recommended to the Government of India, *viz.*, that the money should be disbursed in the villages by responsible officers.

24. *Q.* Would it mean an increase in the establishment of district officers and superior officers?—You were speaking in the case of famine?

25. *Q.* I am speaking of ordinary advances?—Yes. If it was to be done properly, it would need an increase of staff. The officers making the inquiries should be gazetted officers working under the Collector.

26. *Q.* Then you recommend some relaxation of the present rules?—Yes, they require amendments.

27. *Q.* In your experience of so many districts you must have seen a good deal of well-irrigation? In some there is a remarkable absence of wells, and in others they are numerous?—Yes. Well irrigation in this Province is confined to Bihar, including some of the the districts of Bhagalpur Division and Chota Nagpur, I should say.

28. *Q.* Is there any distinct physical reason why it should be confined to those parts? We were told in Chota Nagpur that the rayat was too lazy to draw up water; and that he considers it too much trouble, that the wells were very expensive, and that sometimes there was a great depth of sand and no clay to be found?—I think it is a matter of soil and rainfall; tanks take the place of wells in Bengal proper so far as regards watering of men and cattle.

29. *Q.* Tanks must always fail when there is a deficiency of rainfall?—Yes, to a large extent. It is not my experience that tanks are largely used in Bengal for irrigation.

30. *Q.* These tanks are dug in the soil apparently. They are not the kind of tank which is made by closing in a valley along a hill?—In Bengal they are ordinarily, excavations.

31. *Q.* (*Mr. Muir-Mackenzie.*)—To revert to the point of a cess in Saran, would you be prepared to say that even, although illogical, and although it may not be altogether fair, yet, if the people do not object to the levy of the cess, you would consider it inexpedient to apply it?—How would you gauge the opinion of the rayats and small proprietors of Saran?

32. *Q.* You would have to tell them?—There would be only one answer that they did not want to pay any more.

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33. *Q*. I should be quite prepared to accept that except for the fact that the witnesses in Muzaffarpur were almost clamorous in saying that there would be no objection. We had not only planters but also officials, and they said that the people would not object, and that one of the principal reasons was that the cess would be so minute that it would not press on them heavily?– I should object on the ground that there was no more reason why, for the purpose of benefiting five per cent. or even twenty or twenty-five per cent. of the land of Saran, the whole district or greater part of the district should pay a cess for irrigation than that a cess should be taken from all the districts of Bengal to pay for it.

34. *Q*. I quite admit that the objection is valid and reasonable; but, if people are willing to pay the cess, and inasmuch as the collection of water-rate might be attended with considerable difficulty and expense, would you not be prepared to advocate the levy of a cess, if it was accepted by the people?—No, I should not be prepared to advocate an irrigation cess in Saran. I of course do not object to a water-rate paid by the occupier.

35. *Q*. You said that there was no complaint about the embankment cess?—That is so. The greater part of the district does undoubtedly benefit from the Gandak embankment, not only in the protection of agriculture, but also in the protection of communications. It would not be so with irrigation.

36. *Q*. Do you think that in consenting to the embankment cess, without making any complaint about it, the people reflected in any way regarding its operations?—Yes, intelligent zamindars make such reflections. I think, I remember, that an objection once came from Hatwa that a great deal of the Hatwa Raj, which occupies one-third of the district, does not in any way benefit by the embankment. I also remember that the Bettiah Raj in Champaran made a similar objection with regard to the embankment cess.

37. *Q*. The objection from Hatwa was over-ruled on the ground that the embankment cess did give general benefit?—There was no special reason given except as I have stated that the whole district or nearly the whole district benefits. The cess was put on every estate by a strong Collector 25 years ago, and it is small and nobody minds it.

38. *Q*. If an irrigation cess be put on by a strong Collector now, would there not be an absence of objection?—I do not think we would hear very much objection to a small cess such as one pie or two pies on the rent.

39. *Q*. You would consider the cess was objectionable, and if there was no other means of paying for the work, you would rather see the work abandoned than have a cess put on?—I want first of all to know what benefits can be conferred.

40. *Q*. Suppose we irrigate 100,000 acres, do you think that a cess is objectionable?—Yes.

41. *Q*. If the money for an irrigation project could be got in no other way except by a cess, and if in no other way could you get 100,000 acres irrigated, would you still object to a moderate cess in Saran?—Yes, I should still object. But if it could be shown to me that 100,000 acres would be irrigated and could not be irrigated by any other arrangements, I might give in.

42. *Q*. With regard to well irrigation, do you think that if those parts of the country where wells are suitable and well irrigation is not material, wells are as widely extended as they might be?—No, the number of wells is increasing yearly I suppose.

43. *Q*. And do you think that the rate of increase should be accelerated by a liberal distribution of *takavi* under the Improvement Act system?—I think so. I think that it should be accelerated. It is the custom in the Hatwa Raj to help rayats to make wells. Mr. Tytler was very successful in this direction, and there is no doubt there is room for more wells.

44. *Q*. Can you indicate any particular localities in any districts with which you are acquainted where more might be done?—I should think probably throughout Bihar, not everywhere, because in places the soil is not suitable and there rayats won't dig wells.

45. *Q*. But in places where rayats are backward, are the soils suitable?—This would have to be ascertained. I know that previous attempts to encourage wells have not always been successful. I should attribute some failures to rules being rigid or being unsympathetically worked.

46. *Q*. Do you not think that in a matter of this kind an enormous amount depends upon the individual officer?—An enormous amount depends upon the individual officer.

47. *Q*. If you get a person to take up the subject with enthusiasm, he would influence the people?—Yes.

48. *Q*. Has the Bengal Government ever found difficulty in getting as much money as it wants for *takavi*?—I did not come prepared to answer this question.

49. *Q*. The allotment for the whole province is four lakhs for the current year?—I cannot say.

50. *Q*. Do you remember what it was last year?—I cannot say without looking into returns. I have caused figures to be prepared for the Commission showing the amount actually disbursed for *takavi* in the last ten years.

51. *Q*. But not the amounts asked for? Can you remember any case where the Bengal Government have had to refuse loans?—In this year—I have been Secretary to Government for one year—there has been no case of refusal.

52. *Q*. Do you find that all allotments that you make are generally spent by the District Officer? I regard this as an important question. Can you tell us to-morrow whether District Officers ordinarily spend the allotments made to them?—I think the figures have been compiled for the Commission, but if not, I can have a statement compiled showing the allotments made and the actual expenditure. These depend very much upon the character of the year.

53. *Q*. I understand that the improvements in the system of *takavi* advances which you advocate would be that responsible officers should themselves distribute the money. You would not go as low down as a Sub-Deputy Collector?—Yes. The Sub-Deputy Collector is a gazetted officer. They should themselves distribute the money in the villages and such arrangement has been made in Chota Nagpur.

54. *Q*. Is there any difficulty in distributing *takavi* owing to the insecurity or defective tenure of the rayats?—I would not say that this has been a practical difficulty in Bengal, because in Bengal we have a practice, which may also obtain elsewhere, of joining a large number of rayats in a single bond. We prefer the joint security of 15 or 20 rayats to the mortgage of the holding. We take both; but District Officers ordinarily prefer the joint security.

55. *Q*. Is there not a rule at present that for loans granted for improvement purposes landed securities should be taken?—I should have to consult the rules before replying. There are rules approved by the Government of India in force in all provinces. (Mr. Allen here read the rule.)

56. *Q*. You do not think there will be difficulty in obtaining this collective security even if loans are largely extended? I beg your pardon; when you first put the question I was thinking of loans to rayats which are ordinarily made under the Agriculturists' Loans Act and less frequently under the Land Improvement Act.

57. *Q*. But loans for wells, would they not have to be given under the Land Improvement Act?—Yes, but there we would not always get joint security. We might sometimes get it.

58. *Q*. Loans for wells will benefit only the individual and the security would be his holding?—In most cases.

59. *Q*. I would point out with reference to this matter that Mr. Tytler in Saran in describing the success which he had in giving advances lays stress upon this collective security and he says he was able to get rayats to give such security?—That means that the well would irrigate several holdings. In such cases no doubt.

60. *Q*. You think that such cases would be abnormal?—I think that cases would be abnormal where you would get 15 or 20 rayats to give a collective security.

61. *Q*. Do you want such a large number?—That is an ordinary number in the case of loans under Agriculturists' Loans Act. A smaller number may suffice in the case of a well.

62. *Q*. You referred to the case of the tenure being offered as security and you said that the question did not present any practical difficulty, and that you did not anticipate any in the future? Do you think that the matter of tenure will not present any insuperable difficulty in the future?—It does present difficulty, but this difficulty is diminished in the cadastrally surveyed districts where the rayat can produce a copy of the record-of-rights showing what his title is. There is great difficulty in finding out his rights and

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the area of his holding where there has been no survey.

63. *Q*. But where a record-of-rights is introduced that difficulty is at an end?—To a large extent inquiry is simplified.

64. *Q*. Is there any danger of the difficulty recurring and becoming one of great magnitude if the records are not maintained very punctually?—Of course a record becomes to a certain extent obsolete and loses its value every year, but for practical purposes for 20 years and more it will be valuable, although not conclusive.

65. *Q*. The record-of-rights will greatly diminish the difficulty of testing security?—Yes, it will assist in the ascertaining of details of rights in land.

66. *Q*. When a rayat makes an improvement would he run the risk of having his rent enhanced, or would he be safe from enhancement?—Wherever the Bengal Tenancy Act is in force he is absolutely protected as regards his improvement; that is to say, the improvement cannot be made the basis of an enhancement suit by the landlord.

67. *Q*. I am aware of this provision of the law; but is not it a fact that landlords get enhancement of rent?—I am afraid so in the non-surveyed districts.

68. *Q*. And in the surveyed districts?—Where there is a record-of-rights we believe that the rayat is much safer.

69. *Q*. Now about advances to zamindars. There must be some cases in which zamindars might profitably take advantage and obtain pretty large sums to make irrigation works, such as *pains*, *ahars* and improve existing irrigation works. Do you think there is any scope for advances of this character?—I should say that in Bengal, ordinarily speaking, a landlord does not make improvements. The South Bihar districts where the *bhaoli* tenure prevails, are distinguished by the system known as *ghilandazi* The landlords make and maintain the *pains* or water channels and construct and repair *ahars*. These may be called improvement works; but they must also be looked on as works of maintenance. Without such works there would be no crop. The landlords occasionally take advances from Government for such improvement works.

70. *Q*. Is it not the case that in some districts the *ahars* and *pains* are in very bad order?—Yes, undoubtedly they are often neglected.

71. *Q*. Do you think the landlord could be induced to take advances more freely?—I think so with more encouragement and by selected officers.

72. *Q*. More where rent in kind prevails than where rent in cash prevails?—Certainly.

73. *Q*. Where the system of rent in cash prevails a landlord has very little chance of getting enhancement?—He has the right of enhancement under the law if he registers his improvement.

74. *Q*. But it is not a fact that it is very rarely done?—I would not say that. Some of the great landlords register; but registration of improvements is greatly neglected.

75. *Q*. And even if they registered, are not they precluded from enhancement for 15 years?—No. Under section 113 and section 29 of the Bengal Tenancy Act they can enhance the rent as soon as they make the improvement.

76. *Q*. Is not enhancement forbidden for fifteen years and five years?—The law prescribes periods of fifteen years in the case of occupancy and five years in the case of non-occupancy tenants between enhancement and enhancement, but there is an express exception which would allow immediate enhancement on the ground of an improvement made by the landlord.

77. *Q*. There are a number of Government estates scattered about the country. Do you think that irrigation works made by the landlord are very much better in the Government estates than in the zamindari estates?—I should say that irrigation works on estates under the Government or Court of Wards are better looked after than those on private estates.

78. *Q*. Do you think they are not better in all Government estates?—I do not think enough has been done.

79. *Q*. You would like to see larger sums spent in the Government estates?—Yes. I think more money could rightly and profitably be spent on them.

80. *Q*. Can you say what has been the difficulty up to the present in expending money on Government estates?—I think the Collectors have too much to do Perhaps they should have an agricultural engineer.

81. *Q*. Want of skilled advice?—Yes. Want of skilled advice in the Government estates.

82. *Q*. You would like to have more skilled advice placed at the disposal of Government in the management of estates?—Yes, I would. I do not say that the District Officers have no such advice. They have advice from the Public Works Department and District Engineers, but they want more help.

83. *Q*. It came to our notice in Chota Nagpur that the Deputy Commissioner wished to have rents enhanced in consequence of the introduction of improvements, and that the Board of Revenue objected on the ground that a settlement had been recently made and that a change could not be made for fifteen years?—I cannot remember that any proposal of this nature has come before the Government. There may be special reasons why the Board take this view in the case of Palamau, if Palamau be the district to which you refer. In Palamau I know that rents were considerably increased in the last settlement; and it may be that the Board think that they have been sufficiently increased without putting on anything more on the ground of repairs of *ahars*. It is a possible view of so-called improvements in some of the Government estates that there is no new improvement, but that the works are only maintenance works which it is the duty of the Government to maintain, and that therefore there can be no question of enhancing rents.

84. *Q*. (*Mr*: *Allen*.)—There is a question of carrying out a large scheme—a canalisation of the rivers by which the villagers would be considerably benefited: and the Deputy Commissioner therefore recommended that an additional rent should be charged. He said it would be very difficult to collect a water-rate, but it would be fair to enhance rent. The Board held that it would not be fair to further increase the rent until the expiration of Mr. Sunder's settlement?—There is no provision of law in the Bengal Tenancy Act which would prevent the increase of rent on the ground of improvement. I distinguish between improvements and works which it is the duty of the landlord to make. I should have to refer to the Chota Nagpur Tenancy Act and Settlement laws before speaking positively as to the provisions of the Chota Nagpur law on this subject.

85. *Q*. (*Mr. Muir-Mackenzie*.)—To come to the famine programmes. Have you formed any opinion as to the utility of works done during the last famine? They consist principally of roads and tanks?—Yes, of roads and tanks generally. I have not been a famine officer. I cannot speak with practical knowledge gained in famine time. Mr. Bourdillon would give you full information as to famine works.

86. *Q*. Do not famine programmes come before you in your capacity as Secretary to the Government?—I can say how famine programmes are prepared and dealt with.

87. *Q*. The principal point which I wish to know and on which you can give us information is this Do you think that under the present system sufficient consideration is given to the prospective utility of the works, more especially for the purposes of irrigation?—I think that the question of prospective utility bulks largely in the minds of District Officers when they submit their schemes. I do not say that the programmes are perfect. Much depends upon the personal equation. One officer thoroughly knows his district, and he has got good advice from his District Engineer, from planters and other persons well acquainted with the district. He will prepare a very good programme of works of great prospective utility. Another officer, who knows his district imperfectly and is not so well advised by the District Engineer, might send in a very *kachcha* programme. But the programmes are every year revised.

88. *Q*. Have you any reason to fear that a considerable number of programmes are *kachcha*?—No, I would not say that.

89. *Q*. Do you think the District Officer has time available to prepare a thoroughly well-considered programme?—I do not think so. I think the programme for each district is capable of improvement.

90. *Q*. Do you think that the District Engineer has time enough?—No, ordinarily he has not.

91. Q. Do you think he requires assistance?—I do.

92. *Q*. Do you think in some districts it might be advisable to make a careful survey of the country to discover its possibilities?—I think it is most desirable. I presume that the officer who makes it would not go into the district without any previous knowledge of the work and without carefully consulting local people

93. *Q.* Would it not be preferable to have an officer permanently attached to the district?—The expense would be too great to have an officer permanently attached to the district.

94. *Q.* Why could he not be Assistant to the District Engineer and have other work as well?—I think it would be very desirable, if funds permitted.

95. *Q.* Now as to the proportion of the population for which work is provided, can you tell me on what basis it is fixed?—The number of people for whom work is provided is mainly estimated with reference to the previous famine history of the district.

96. *Q.* We will first take the district of Burdwan?—I find you provided work for 21,000 persons for three months, while the average daily number employed was 11,000 odd?—We now estimate 14,138 as the maximum number of persons likely to require relief on works, though we provide works for 21,517. The difference is not very great. Since 1873-74 I suppose there has been an increase of population in Burdwan. I take it that the Collector considered the population of the area which he returned as liable to famine, and estimated with some reference to the famine of 1873-74, that such and such percentage might be employed on works.

97. *Q.* On the other hand, we will take what might be estimated to be the worst district, Darbhanga. The highest number employed in 1873-74 was 569,000. In 1876-77 the highest number employed in one day was 149,000 and the average daily number over the whole period was 82,000. You provided for 176,000?—I should have to refer to reports before explaining the figures. I think the Darbhanga figures are now under inquiry.

98. *Q.* Is any rule laid down that estimates are to be made on the basis of what happened in 1896-97 and 1873-74; if so, can we see the rule?—On page 3 of our Famine Code it is laid down that estimates shall be made (*a*) with reference to the experience of previous famines, (*b*) with reference to the general condition of the various sections of the population.

99. *Q.* The rules seem to be different in different provinces?—In Bengal we estimate for each district with reference to the previous experience of the district.

100. *Q.* (*Mr. Rajaratna Mudaliar.*)—You said in reply to Mr. Muir-Mackenzie's question that there is no legal objection to the leavy of a water-rate or cess during the currency of a settlement, when the irrigation is supplied at the cost of the Government?—For levy of an occupier's rate for water our law provides. For levy of a cess it does not provide. To enhancement of rent on account of an improvement made by the landlord there is no legal objection.

101. *Q.* Supposing an irrigation work is made during the currency of a settlement, can you raise rent by transferring land from a lower to a higher class?—You are speaking of rent, not revenue. Revenue is fixed for a period. Government could not intervene so as to take a higher revenue from a zamindar during the period of settlement.

102. *Q.* I do not mean a zamindar; I am speaking of a tenant of a Government estate?—There is no legal objection to the enhancement of rent where a new work of irrigation is constructed by Government during the currency of a settlement.

103. *Q.* If an existing work be improved substantially, could you enhance rent during the period of a settlement?—Legally you could; in practice I doubt if this is ever done on a Government estate.

104. *Q.* Don't you issue a notification at the time of the settlement and is no provision made for enhancement in such a case?—You are speaking of improvements to be made between settlement and settlement. There is no practice of making a notification of that kind.

105. *Q.* (*Mr. Muir-Mackenzie.*)—But you do notify that rents will be fixed for such a period?—Yes, that would be recorded in the settlement proceedings. Government fixes the term of settlement and it will be well known to the rayats of a Government estate.

106. *Q.* It is not specially notified?—It is well known; but I cannot remember that there is provision for special notification of a period of settlement unless in the Sonthal Parganas. Ordinarily in the case of any big settlement the results are reviewed in a Resolution which is published in the Gazette, and in this way the period of settlement might be said to be notified. We have no provision of law unless in the Sonthal Parganas obliging such notification to be made.

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107. *Q.* (*Mr. Rajaratna Mudaliar.*)—In Madras there is a provision by which, when the water-supply for irrigation purposes is improved or a new work is constructed, the assessment may be raised?—We have no such provision in our settlement code; but I have stated that the Bengal Tenancy Act would allow enhancement of rent between settlement and settlement in case of an improvement duly registered.

108. *Q.* As regards security for loans, you said that there was no difficulty in areas where a record-of-rights has been prepared?—I say that the procedure is very much simplified as regards security. Where there is a record-of-rights inquiries as to security are very much simplified. I mean it is easier to ascertain whether a man has a holding or not, and whether the holding is recorded in his name only and what are the area and rental.

109. *Q.* Whether he is an occupancy tenant or not?—Yes.

110. *Q.* If he is found to be an occupancy tenant, he is safe?—Nearly all our tenants are occupancy tenants.

111. *Q.* Then what is the difficulty in the case of a district where there is no record-of-rights prepared?—The difficulty is that there is nothing to identify the holding of an applicant for an advance. There is nothing but the rayat's statement as to what land he has.

112. *Q.* Does not the proprietor keep accounts?—The proprietor keeps his *jamabandi* or rent-roll; but it would be without survey numbers of fields; it might or might not be correct; it might contain an obsolete name. It may not contain the present rayat's name.

113. *Q.* Do you obtain a certificate of encumbrance, as we call it, from the Registration Office?—I do not know the term.

114. *Q.* Where the land is mortgaged to others do you go to the Registration Office and make inquires?—We might do so in the case of a zamindar taking a loan for a large amount. We would not ordinarily think of doing so in the case of a tenant.

115. *Q.* (*Mr. Allen.*)—As regards the Saran Canals, it was urged before this Commission, particularly by Colonel Hodding, that the effect of the embankment was that it kept water out of the streams which, previous to its construction, would have come into the streams; therefore the maintenance of those channels would be more or less connected with the embankment. In other words, the cost of keeping the embankment up ought to include the cost of maintenance of the canals. He used that argument as justifying the levy of a water cess. Do you think this a strong argument?—The embankment prevents water from coming in and flooding the district whereby the district gains; but it keeps water out of the channels and thereby the district suffers; therefore Mr. Hodding's argument would be, I suppose, that it would be right to impose a future cess or an increased cess in order to bring in as much water as would be useful. This is an ingenious argument which I have not sufficiently considered.

116. *Q.* This is urged as a reason for including the canalisation as a part of the embankment scheme?—Yes, now I remember one of the engineers did suggest that the work of keeping the canals open might be connected with the embankment scheme, and that an addition might be made to the cess on this account. There are no doubt complicated questions connected with the embankment with regard to sluices and drainage. But I should not, without full examination, be prepared to accept this argument of Colonel Hodding's that because the embankment prevents the water coming in and flooding the district and keeps water out of the channel, it would therefore be right to impose an additional cess in order to keep the channels open. I have myself advocated more sluices in the embankment to let in water and to let it out. I would refer to a note which I wrote on the embankment two to three years ago.

117. *Q.* (*Mr. Muir-Mackenzie.*)—But you do not think that an additional cess should be made to provide sluices?—The sluices which have been proposed, so far as I am aware, would not have any great effect in filling these four canalised rivers.

118. *Q.* (*The President.*)—The argument is that you are merely restoring the *status quo*, and that the people had a right to have this water given back and that you are bound to do more in the way of canalisation to restore this benefit to the people?—I think that it might be examined. I should not like to express any opinion on this question straight away

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119. *Q.* From what we have heard probably the country had been enormously improved by the embankment. Probably it used to be devastated by the floods?—There is no question, I think, that the Saran tract is benefited by the embankment. It may have lost the benefit of silt; but in this district agriculture has undoubtedly benefited by the protected of this particular embankment. I would not hastily express an opinion about embankments in other districts; but with regard to the Gandak embankment in Saran, I do not think there are two opinions as to the great benefit which the district has derived from it.

120. *Q.* (*Mr. Allen.*)—Do you think it advisable that tenants should be given further protection in Chota Nagpur with regard to improvements than at present?—I do. Rayats have absolute protection in Bengal in theory—at least in the Bengal Tenancy Act where that Act is in force. We have given them complete protection also in the Sonthal Parganas and they should have such protection in Chota Nagpur.

121. *Q.* With regard to the Chota Nagpur Encumbered Estates Act, there is a section; I think it is clause 4, section 4, which gives a Deputy Commissioner and the District Officer authority to spend money on the estate. The Commissioner suggested that considerably more money might be spent under that section on the maintenance of *ahars* and other irrigation works for the improvement of the estate. Do you agree in that opinion?—That requires a great deal of thinking about. The scheme of management of the encumbered estates in Chota Nagpur is drawn up principally in the interests of the zamindar whose estates are taken over and in the interests of his creditors. Anything that would prolong the management of the estate and would increase the period in which the debts are to be re-paid may be argued to be unfair to the creditor. The law already provides for the cost of reasonable improvement of the property included in the scheme.

122. *Q.* (*Mr. Muir-Mackenzie.*)—Not only that it gives priority to improvements of the land?—Yes, I would be in favour of a very liberal interpretation of the duties of a District Officer with regard to works of agricultural improvement which would clearly benefit the estate and the tenants.

123. *Q.* (*Sir Thomas Higham.*)—With regard to the programme of relief works, are these prepared in your department?—They are prepared by District Officers who rely on the District Engineers for the small village works and on the Executive Engineers and Superintending Engineers for the larger works.

124. *Q.* They are examined in your office?—They first go to the Commissioner who examines them and who may consult the Superintending Engineer; then they come to Government in the Revenue Department. The Revenue Department not infrequently consults Government in the Public Works Department about the programmes. Every work which is to employ more than a thousand persons for three months requires to be sanctioned. Small village works are entered by the District Officer in the programme without the special sanction of higher authority. Larger works have to receive special sanction.

125. *Q.* Then small works are not scrutinised?—I would not say that. They are scrutinised in this way that the Commissioner and the Secretary in the Departments would go through the programme, perespecially to see that every thana or police circle had works provided.

126. *Q.* They would scrutinise as to distribution?—As to distribution, yes, and there is further scrutiny. Only yesterday I had a programme from a district in Orissa. The District Officer proposed to spend money on raising two roads. The matter was referred to the Public Works Officers and they objected. They said that the raising of these roads would prevent floods from the Subarnrekha river passing over the country. The proposal was vetoed on that account. I would not say that the programmes are thoroughly scrutinised. More scrutiny is desirable.

127. *Q.* Then as to the statement with regard to the maximum number requiring relief in the event of famine. How is the maximum number got at?—On the basis of the figures with regard to the number of persons who were relieved in the famine of 1873-74 or 1896-97. Our Famine Code lays down that the experience of previous famines is to be the guide.

128. *Q.* Who scrutinises them? Who determines what maximum number of persons is to be entered as requiring relief?—We have no general rule of percentage. We do not say 5 or 10 or 20 per cent. We depend upon previous experience and the judgment of the District Officer and Commissioner. There is often much discussion of the figure. I can remember as District Officer making an estimate which my Commissioner would not accept. I took the figures of 1873-74, and my Commissioner who knew the district better than I did and who had served in it in the famine of 1873-74 said that the figures of 1873-74 would not do; that relief works had not been properly administered in 1873-74; and he cut down my estimates, I have no doubt, rightly.

129. *Q.* Would you enter the maximum for whom relief would be provided for three months?—Yes.

130. *Q.* But famine would be expected to last for more than three months?—Certainly. The pinch would begin in about December and the maximum number would be employed in May.

131. *Q.* The maximum for three months would be equal to the average for five or six months?—Yes, it would be so.

132. *Q.* But you have provided a great deal more in some districts?—Yes. District Officers have sometimes prepared full programmes providing for more works than would probably be required.

133. *Q.* (*The President.*)—These three months' programmes to some extent mean something to go on with while you prepare some more schemes?—Yes.

134. *Q.* (*Mr. Muir-Mackenzie.*)—The preparation of new projects for famine is very unsatisfactory?—Our code says that we should provide one work for every 16 square miles.

135. *Q.* One work for how many days or months?—That is not laid down.

136. *Q.* Looking at this table it appears that the greater proportion of the works are small works?—Yes, small works. The recent Famine Commissions have greatly encouraged small works.

137. *Q.* (*Sir Thomas Higham.*)—Have you a detailed programme for these small works?—Yes; every year there comes up a list of tanks and roads. I can give the programme to you in print for every district.

138. *Q.* Up to when?—Up to this year, 1902-03. Every year now programmes are sent up—sometimes revised, sometimes with little or no revision of last year's programme.

139. *Q.* Do you know what these village works consist of?—Chiefly roads; but we encourage tank digging—excavation or re-excavation. Our Code says that tanks are more suitable as relief works than roads, because control of labourers is easier on tanks than on roads. We encourage tanks not only because we can collect the workers better, but as works of permanent utility.

140. *Q.* By tanks you mean deep holes in the ground dug wherever you find it necessary to employ the labour, and generally all that can be said for them is that they are good for collective labour?—Yes, and for drinking water for men and cattle. They are not largely used for irrigation.

141. *Q.* They are the sort of work that was going on in 1896-97 in Bihar?—Yes.

142. *Q.* In almost all the districts we have been to they tell us that they do not include the re-excavation of *ahars* that have silted up; and as it is a rather expensive business, zamindars will not do it and the rayats will not do it and Government will not do it. Is it not contemplated that works of that sort should be done by relief labour?—Yes, as far as I know, not much has been done in repairing *ahars* as Government relief works. Zamindars, as a matter of fact, ordinarily repair *ahars* and sometimes take advances from Government for such work.

143. *Q.* During famine?—Yes.

144. *Q.* If Government relief works cannot be opened on these private *ahars*, you must rely on the zamindar taking advances?—Yes.

145. *Q.* But is there no reason why in a time of famine, when it is very difficult to find useful work, *ahars* should not be made instead of making mere holes in the ground?

The President.—It is giving a present to the zamindar.

Mr. Macpherson.—It is doing his work for him. I should prefer to do the repairing of the *ahars* to making holes in the ground as you put the case of the drinking water tanks. I am not aware that the matter has been threshed out in Bengal as to the expediency of giving help to the agriculture of the country in this way by repairing of the *ahars* and by employing relief workers on agricultural works of this kind.

146. *Q.* Of course one difficulty is that you cannot supervise it properly. Supervision would be more difficult for work of that sort than tank digging. You could not trust to zamindars to employ and pay labour. To disburse this money?—I think that these difficulties might be got over.

147. *Q.* I think that some of those tank works are on Government land. You do not re-excavate tanks on a zamindar's land?—I think we have re-excavated many tanks on zamindar's land. It has been claimed by District Officers in Bihar that when a tank is excavated by famine labour, certain public rights must in future be asserted. It is very common to re-excavate zamindars' tanks.

148. *Q.* You do not often clear out *ahars*?—I should say it is not common to clear out *ahars* as Government relief works.

149. *Q.* (*Mr. Muir-Mackenzie.*)—I should like to know whether you advocate the preparation of records-of-rights in water on the same lines as the records-of-rights that you have prepared with regard to rights in land?—The question was considered in Gya about seven years ago and may have attracted attention later. The Collector, Mr. D. J. Macpherson, strongly recommended, if I remember right, that there should be a record-of-rights in *pains*, *i.e.*, of the Paharas, or rights of different villages or different landlords to respective periods of days or hours for enjoyment of the water. That was in connection with the survey of the Tikari estate in Gya. I think that we hesitated to make this record as involving decision of a large number of disputes. I am not sure how far the decision of the Revenue Officer with regard to water-rights would be binding in the Civil Courts.

150. *Q.* That is what was thought, but what is your opinion? Mr. Oldham and Mr. Ogilvy strongly support this view?—They have had great experience.

151. *Q.* (*Mr. Allen.*)—There is a clause in the notification about the Maksudpur settlement with regard to record of customary rights of irrigation, especially with regard to the duties of landlords about irrigation works?—It would be useful no doubt to have a record-of-rights in water or even a note on the subject in the village record-of-rights. If a binding decision is to be given, however, I take it that it must be given by a Civil Court. I speak without recent examination of the law on this point. Then it is asked whether it is desirable that Revenue Officers should decide such questions. Ordinarily when a record-of-rights is being made, the work in the Revenue Officer's hands is so gigantic that we are anxious to limit it to essentials. In a tract of a district containing half a million fields the Revenue Officer may find that in 50,000 fields there are disputes with regard to proprietary right or tenant right or some other question. We have hesitated to add to the record details with regard to rights in trees, details with regard to tanks, etc., and have kept the Revenue Officer to essentials concerning the land. But I am certainly of opinion that a Revenue Officer is more competent to decide the question of existing rights in water than a Civil Court.

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152. *Q.* Do you think that the obstacles and expense and difficulties in making a record-of-rights in water are so great as to make it impracticable to carry it out?—No, I do not think they are too great. It is a matter of officers.

153. *Q.* And time?—And time.

154. *Q.* And if it was carried out, do you think that it would be distinctly beneficial?—I think it would be distinctly beneficial.

155. *Q.* There is one other point connected to a certain extent with the same thing. Mr. Oldham strongly recommends that the Collector should have power to compel persons in most instances to keep *pains* in repair, and even *ahars*. The machinery that he proposed was that the Collector on receiving a complaint that they were out of repairs should give notice to the zamindar, and if he did not repair within a reasonable time, the Collector should repair and charge the cost to the zamindar. Would you be prepared to advocate anything of that kind?—The zamindars would be allowed, I suppose, to show cause why the *ahars* should not be maintained or why the *pains* should be allowed to go out of repair.

156. *Q.* We may take it that the *ahar* is in such a state of disrepair as to make it necessary; and Mr. Oldham said in Gya that such neglect is common?—Mr. Oldham knows his district very well and he has no doubt thought a great deal about this subject. I cannot speak from great personal knowledge of it. I have heard that in Palamau two *ahars* are in a state of disrepair.

157. *Q.* Are there any grounds why such a power should not be given to the Collector?—The question arises whether it is often necessary for the Collector to interfere. If the zamindar does not repair his *pains*, there is no crop. He gets his rent in kind, and the question is whether any penalty in addition to this loss of crop should be inflicted by the law. About 75 per cent. of the Gya district is leased on *bhaoli* or produce rents. It is a new idea to me that a penalty should be inflicted on landlords who neglect their duties in this matter; but I do not say that it would be wrong to give District Officers power to do necessary works which the landlord neglects. I hesitate to give an opinion, but would say that the zamindars should always be allowed to show cause to the Collector as to why he does not repair the *pain* or *ahar*.

158. *Q.* Mr. Oldham represents that there are very serious disputes now going on with regard to the making of *pains*; those disputes sometimes lead to riots and bloodshed, and the Collector has to make an order if there is going to be a breach of the peace. He says—"I should be allowed to interfere before and to give an order as to how the stream is to be regulated." Would you be prepared to support that? I do not want to urge you to express an opinion?—Yes, I think it is better that the Collector should settle that than the Civil Courts. I should agree with the Collector. He would hear both sides and would sometimes want skilled advice; I should prefer his decision to the Munsiff's. It would save a great deal of litigation and expense.

Mr. M. FINUCANE, Commissioner of the Presidency Division.

(Calcutta, 8th November 1902)

Mr. M. Finucane.

1. *Q.* (*Mr. Muir-Mackenzie.*)—You are now Commissioner of the Presidency Division?—Yes.

2. *Q.* You have been Director of Land Records and you have also been Manager of the Darbhanga Estate? -I was Settlement Officer in the Darbhanga Raj and also acted as Manager of the Darbhanga Raj.

4. *Q.* You have also been Revenue Secretary to the as Director of Land Records and Agriculture and in supervising the survey and record-of-rights in Bihar at the beginning of the operations there. I had experience of Bihar also as Manager of the Darbhanga Raj, and during the famine operations of 1896-97 I went over North Bihar several times examining famine operations there.

4. *Q.* You have also been Revenue Secretery to the Government?—Yes, and Secretary to the Board of Revenue.

5. *Q.* I may add you have special knowledge of tenancy questions, having given great attention to it and written a book on the subject?—I do not know that writing a book implies great knowledge. At any rate I have given special attention to the subject.

6. *Q.* I will, first of all, ask you if you have any opinion to give on any of the larger schemes of irrigation suggested to us?—I have had no special experience of any of the larger schemes of irrigation. They never came officially before me for examination either as Revenue Secretary or in any other capacity. They are managed here by the Public Works Department. I may say that no large scheme of irrigation has ever been officially considered for the Presidency Division. In Nuddia and Murshidabad there are about 1,400 square miles in which distress prevailed in 1896-97. The distress in Nuddia was not quite so bad as the northern parts of Bihar, but still it was very severe there. Dwarkanath Sircar, Rai Bahadur, who was for 20 years or more District Engineer of Nuddia, and who supervised famine relief operations there, tells me he has two schemes now to suggest. One is a canal from the Ganges from Laltakuri *viâ* Barhampur and Nuddia down to a place that is 6 miles north of Krishnagar (showing the map). The other scheme is the canalisation of the Bharub river. I need not go into details. Whether these schemes are feasible or not, I cannot say. I can offer no opinion on that point, but the Rai Bahadur is here, and if the Commission wish to examine him he will be able to explain these schemes.

7. *Q.* Do you consider Nuddia liable to severe famine?—Yes, part of it is.

8. *Q.* I see that in 1896-97 the numbers employed on works was only 11,000?—Nuddia suffered in 1873-74; again in 1896-97.

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9. *Q.* What relief was given ?—Relief works were started and gratuitous relief was given.

10. *Q.* To how many people ?—The total number of persons who actually received relief on Nuddia relief works in 1896-97 was 3,712,566 units.*

11. *Q.* That is not at all large compared with some districts ?—It is as large as Saran for example, and is the number for part of the district; whereas the Saran figures are for the whole district. The percentage of the numbers that received relief in Nuddia on the entire population of the area affected was as large in Nuddia as in the worst parts of Bihar. I do not say these districts are so liable to as severe famine as the worst parts of Bihar, but they suffered from famine on every occasion that we have had famine.

12. *Q.* Is that the number of persons on works or the number of persons receiving relief ?—It is the number of persons on relief works. The number of persons on gratuitous relief was very much higher. The highest number on relief works in Nuddia in 1896-97 at any one time was in round numbers 28,000 and on gratuitous relief 83,000.

13. *Q.* Do you know why the number of persons on gratuitous relief was very much higher than those employed ?——One reason is that it had never been the custom for Mahomedan women in that part of the country to do outdoor work. We found that the women and children were getting emaciated at the start and refused to come on to relief works, and therefore we had to distribute gratuitous relief to them more freely, and with less severe tests than elsewhere; and, secondly, the Collector did not, I think, sufficiently insist upon people being driven to the works instead of giving them gratuitous relief. The number of persons on relief works was less than it might have been expected to be, and the number on gratuitous relief was much larger.

14. *Q.* We were told that Nuddia is likely to be as severely affected as Saran ?—Yes, a particular part of it. Saran was not very severely affected, and in fact the distress in that part of Nuddia to which I refer was far and away more severe than it was in any part of Saran. I had been over the whole famine area in Bengal and Bihar several times during the famine of 1896-97 except Chota Nagpur and Bhabua where alone the Famine Commission found fault with the insufficiency of the relief given in Bengal and can testify of my own knowledge that the distress in parts of Nuddia, and the failure of the crops there was far greater than in Saran, and that the people there were quite impoverished. The soil is a light sandy soil, and a bad system of land tenure known as the ***utbandi*** system prevails there.

15. *Q.* (*The President.*)—Is there any possibility of developing minor irrigation works in Nuddia ?—It is not the practice to irrigate from wells there, but it may be feasible to do something in that way.

16. *Q.* The matter will require a great deal of inquiry ?—Yes, and the people would have to be trained to well irrigation. They know nothing about it at present in that part of the country.

17. *Q.* Can you tell us anything regarding minor irrigation such as ***ahars, pains,*** canalisation of streams, etc. ?—When I was Settlement Officer in Darbhanga, I surveyed and settled the rents of entire parganas and was engaged in that portion of the country near the Nepal frontier for several years, I found the people themselves made ***bunds*** across the hill streams that came through from the Nepal, and they irrigated their lands from the water diverted from these rivers. They first made anicuts and took water by means of them from above these ***bunds*** and drew it on by smaller drains to their fields. When the ***bund*** was made higher up the stream and shut off the water lower down, the people from below came at night and sometimes by day, and cut the ***bunds*** (which were made of earth) with the result that rioting often ensued. It occurred to me at the time that it might be useful to make permanent weirs and sluice gates on these rivers, and I had the country examined by an engineer with a view to ascertain whether that could be done. He drew up plans and estimates, and the scheme was considered by the Court of Wards under which the Darbhanga Estate was at the time. The Court of Wards said it was a most valuable scheme and ought to be carried out; but as the estate was soon to pass out of the hands of the Court of Wards, they preferred it to let it lie over until the Maharaja came of age. I left the Darbhanga Raj before anything was done. I understand that nothing has since been done in the matter. It is worthy of inquiry whether the water-supply from the hill streams coming down from Nepal cannot be utilized more than it has hitherto been utilized in areas which are not commanded either by existing canals, or that may not be commanded by proposed canals. The estimated cost was only half a lakh or one lakh, and the Raj rayats were willing to assist with labour and the Maharaja would perhaps be also glad to contribute.

18. *Q.* Have you never been confronted with the objection that the river was bunded up in Nepal, and that you would not get water at times ?—Yes. The rivers are sometimes bunded up in Nepal, but if that were always the case, there would be no use in rayats making ***bunds*** lower down as they do; the people would not build these ***bunds*** if ordinarily the water is not allowed to come down. In a season of drought there might be that difficulty.

19. *Q.* What would be the use of permanent ***bunds*** if the water is shut off ?—As a matter of fact, the water is not shut off in ordinary years. In years of great drought it is perhaps shut off, and in years of short rainfall in Nepal these ***bunds*** might possibly be of little use. Our rayats very often went up and cut the ***bunds*** in Nepal.

20. *Q.* I suppose they (the Nepalese) have the right to make the ***bunds*** ?—Yes.

21. *Q.* (*Mr. Muir-Mackenzie.*)—At any rate there is this imperfection in the scheme that in a year of drought the water might be cut off ?—Yes. The scheme is not a guarantee against famine, but it would be most useful at other times and it may be in famine times if the Nepal authorities can be persuaded to let surplus water come down. In 1897 complaints were made that the Nepal authorities stopped the importation of grain. We addressed the Government of India and asked them to bring influence to bear. I do not know what was done. At any rate the prohibition regarding importation of grain was withdrawn. The Government of India also addressed the Nepal Durbar about ***bunds*** and the Nepal authorities helped us.† It may be possible to make arrangements with Nepal regarding ***bunds*** and to arrange that the Nepal authorities should have sluices of their own.

22. *Q.* You think that the Nepal Government is not likely to prove unreasonable in the matter ?—I think it may be possible to make some arrangements with Nepal, but cannot say for certain. The Nepal Durbar helped us in 1896-97.

23. *Q.* It occurs to me that in self-defence Nepal would take all the water that it could ?—Quite so, but Nepal may arrange to let water come down when not required for its own people.

24. *Q.* If you had had this scheme carried out, would they have taken the water every year ? We have had some evidence of the fact that they would not want water in good years; perhaps not more than once in four or five years ?—In that part of the country to which I refer in the north-east of the Darbhanga district, Alipur Pargana, which is a rice country, they want water every year; they make ***bunds*** every year; I cannot say this would apply to the whole of the country. It is almost impossible to enunciate any proposition that would apply to the whole of the country.

25. *Q.* You do not know anything about these little canalisation schemes of Mr. King ?—No, I have never seen them.

26. *Q.* With regard to the canalisation of the Kamla, Mr. King said that though all the other streams may be bunded up by Nepal, the Kamla would not be bunded up. I cannot say whether your schemes are connected with the Kamla ?—No; an account of my schemes was in my settlement report of Pargana Alipur. (Report handed in.)

27. *Q.* In this country you consider there is considerable room for extension of minor irrigation ?—My opinion is that the matter ought to be carefully inquired into by professional officers of the Public Works Department. I should not like to go so far as to say that there is a possibility of extending these ***bunds*** everywhere in North Bihar. I should think it would be best to have the country surveyed and the possibilities of extending ***bunds*** and other minor irrigation works inquired into by the Public Works Department.

28. *Q.* You would approve of an official being given to assist the District Board in carrying out works of this kind ?—I think it would be better to give an officer to the Collector.

29. *Q.* How would you propose that a work of this kind should be paid for ? Would you be in favour of the imposition of a cess as regards these minor works ?—If the Government drew up a well-considered scheme and laid it before the landlords and tenants of the areas affected, and the people knew what the cost would be and the benefits derived, I should like to leave it to themselves to settle how the cost should be paid. In some cases tenants would be very glad to pay and in other cases landlords would be benefited and would agree to pay, and in some cases the Government

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* ***Vide*** appendices to Resolution of Bengal Government on the famine of 1896-97, Statement IV.

† ***Vide*** Government of India letter No. 230-F.—[illegible]-82, dated 14th January 1898, Vol. III, Bengal Famine Selections, page 1.

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could possibly be benefited. Where land is brought under cultivation by irrigation which would remain uncultivated but for irrigation, the landlords would get rent for newly cultivated land which they otherwise would not receive at all and should be called upon to pay a large proportion of it, when the outlay incurred for bringing the land under cultivation was not made by themselves. As regards the land already under cultivation, the rayat chiefly gets the benefit of irrigation because the landlord is not entitled to enhance rent for works of improvements which he has not himself paid for, but he gets some benefit in the shape of security for the regular payment of his rent. Therefore it would be impossible to say generally whether a cess should be imposed on one or the other, or both. In each case it would be very much a matter of arrangement. The general principle should be that those who benefit by irrigation should pay for it.

30. *Q.* You would tell them what the cost is, and if they accept it let them pay?—Yes, but the imposition of a cess on landlord and tenant generally would, I think, be objectionable and difficult to work equitably.

31. *Q.* Is the machinery that is employed in the Embankment Act or the Drainage Act suitable for consulting people as to what they have to pay?—The District Boards have power under the Bengal Sanitary Drainage Act to undertake large or small schemes of drainage which are intended to improve the sanitation of the locality and a cess extending over 30 years is imposed, on the principle of the road cess, on landlords and tenants in order to pay the cost of such schemes. A large drainage and embankment scheme has recently been proposed in the 24-Parganas under the Bengal Sanitary Drainage Act and the landlords and tenants have agreed to pay for it by a cess extending over 30 years.

32. *Q.* And as regards irrigation works?—There is no objection in principle to District Boards carrying out a work of irrigation, but the difficulty is in devising a cess which would be just and fair and which a District Board can be reasonably expected to realise. There may be no difficulty in handing over the carrying out of these works, but there is difficulty in the cess itself. As regards money spent on sanitary drainage works, all the landlords, tenants and others of the area affected benefit by sanitary improvements brought about at their expense. They all benefit by the sanitation of a country. In the case of irrigation works that cannot be said. Some derive benefit; others do not. Some holdings benefit and some do not. Some fields in the same holding benefit and others do not. The District Boards have not got the agency by which they could distinguish in what portion of a given area a cess should be imposed and in what it should not. There may be cases in which the District Board with the consent of the people concerned could start a scheme and realise a cess. I would simply empower them to undertake such works, but I would not give them power without a full reference to, and approval by, Government to impose a cess for irrigation works. A cess must be apportioned fairly and equitably according to the benefits received for it, otherwise some individual interests may gain and others suffer.

33. *Q.* The consent of the people has to be taken under the Embankment and Drainage Act; how is it obtained?—Notices are issued and the majority of the landlords' opinion is given effect to.

34. *Q.* What notice? By beat of drum?—The consent of the people affected by an embankment or sluice has not to be obtained under the Embankment Act II, B. C. of 1882. The Government is empowered to act without their consent after their objections have been heard. Objections are invited by notices, proclamations and beat of drum. Under the Bengal Drainage Act the assent of the majority of the landholders is required before a drainage scheme can be undertaken, and their assent has to be given in writing. Under the Bengal Sanitary Drainage Act the District Boards or Municipalities affected have to apply for any sanitary, drainage or other scheme they may wish to carry out.

35. *Q.* The consent of the majority is sufficient?—Yes, where consent is required, *i.e.*, under the Drainage Act and Sanitary Drainage Act.

36. *Q.* No attention is paid to the views of the minority?—They have to pay their share of the costs, but objections of the minority are received in writing and considered by Government before a scheme is sanctioned.

37. *Q.* In reference to the management of works by District Boards, I distinguish between other District Boards and those that we call strong Boards as in Bihar where a lot of European planters and big zamindars are on the Board?—I am afraid that Bihar is just the very place where I would insist upon a full report to the Government as to the justification of the cess, and I would insist upon an approval of it by the Government before I allowed the District Boards to impose it.

38. *Q.* That is not my point. As regards the management of works, there would be a better chance of intelligent and careful management of such a Board as I referred to in Bihar than elsewhere?—Yes, but I would not allow a cess in Bihar to be imposed by the District Board for irrigation works without the knowledge and approval of Government. In the case of drainage, embankment and sanitation works from which landlords and tenants alike benefit, I think a cess on the principle of the road cess is justifiable, and that it affords the most convenient way of realising the costs of such works. Under the Drainage Act VI of 1880 the costs of drainage schemes are realised from proprietors and tenure-holders holding at fixed rates and they are left to sue their tenants for enhancement of rent on the ground of the improvement effected by the embankment or drainage work or to arrange for optional payment of the costs by the tenants (see sections 42 and 43 of the Act). I think this is not fair to the proprietors The cost of such schemes should be realised from landlords and tenants by a cess on the principle of the road cess, and this would popularise such works. If it could be shown that any particular irrigation work would benefit all the landlords or tenants, or both, of a particular area, there would be no objection to the imposition of a cess on all the landlords or tenants, or both, over that area in proportion to the benefits received.

39. *Q.* Is your knowledge of Saran sufficient to enable you to give us an opinion as to whether you would allow a cess there?—I have read papers on the subject which came before me as Revenue Secretary. I should not like to offer a positive opinion without knowing more of the local conditions, but it struck me on going through the papers that the cess would not be justified.

40. *Q.* Why not?—If you consider the subject from the owners' point of view, there is the objection to it which I have already mentioned that they cannot get enhancement of rent on the ground of irrigation works which have not been constructed at their expense and therefore a cess cannot be justly imposed on them. If the cess is meant for the tenants, they can at present take water and pay for it if they wish, and if they do not wish to take it, it is difficult to justify forcing them to take it. I am not, however, prepared to say positively that the local conditions may not be such as to justify a cess.

41. *Q.* I would like to know whether you consider that any additional stimulus could be offered with advantage to landlords or tenants to improve their means of irrigation by securing to them a return for their outlay?—Under the law, as it stands in Bengal, every inducement which is possible by law to hold out for encouragement of improvements by landlords and tenants is afforded by the Bengal Tenancy Act. A landlord can, under the existing law, if he proposes to carry out an improvement, take an agreement from the tenants beforehand for payment of enhanced rents. There is absolutely no restriction as to the amount of enhanced rent that a landlord can take by contract from his tenants on the ground of improvements executed at his expense. If the tenants will not agree by contract to pay enhanced rent in consequence of a landlord's contemplated improvement, he can under the law still make it and sue for enhancement of rent and get his enhancement, so that as far as the landlord is concerned the law does all that it can do in the way of encouraging him to make improvements. Now, as regards the tenants, the majority of them, both in Bihar and Bengal, some 80 per cent., I think, are occupancy tenants. They have occupancy rights. If an occupancy rayat digs a well or makes a tank or carries out any other improvement, at his own expense, he is entitled under the law to have the benefit of that improvement to himself and to his successors for ever. The landlord cannot enhance the rent on account of an improvement executed at the expense of the rayat, and if by any means the rayat should be ejected, he is entitled to compensation for the unexhausted value of improvements made by him. An occupancy rayat is also entitled to make improvements without the consent of the landlord unless the landlord wishes to make it himself and *vice versâ*. I do not see that the law can do anything more in securing to landlords and tenants the benefit of improvements made by them.

42. *Q.* Do landlords and tenants thoroughly understand their privileges under the law?—I think not; it may well be asked why it is when the law is so much in favour of improvements being carried out that no great improvements have been carried out since the Bengal Tenancy Act has been passed. The reasons are as regards the landlords in Bihar

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that there are a great many co-sharers in the same estate and they will not all agree and combine to carry out improvements. The rayats do not understand the law. Even when they wish to make wells or tanks they sometimes have not the necessary capital, and again I am afraid that difficulties are placed in the way of the rayats sinking wells or making tanks, or carrying out other improvements by landlords exacting *salamis* and placing other difficulties in the way.

43. *Q.* Can you suggest any steps which could be taken to make rayats better acquainted with their privileges under the law? The record of-rights which is being made in Bihar will, to some extent, enable the rayats to understand their rights, especially with regard to the question of enhancement of rent which is the most important thing, because any man who gets a document as the rayats all do where a record-of-rights is prepared, stating what his rent is, and what he is liable to pay, will probably refuse to pay any higher rent illegally demanded than that entered in that document. I think it would be possible to enable the people in the villages where record-of rights are made to understand what these rights are in the matter of making and benefiting by works of improvement. I also think that, with reference to sinking of wells and making of tanks, much may be done in the way of facilities by giving of loans under the Land Improvement Act.

44. *Q.* You think that, with the object of enabling tenants to understand what their rights are, the preparation of the record-of-rights will constitute a considerable step in advance, and that where it has been framed they understand better than they did before? I think that they certainly understand what their position is better than before. I am not aware of any special steps having been taken to make them better informed as to their rights regarding improvements, but that they understand their rights generally better where a record-of-rights is prepared admits of no doubt whatever. I proposed long ago that an abstract of the rights and liabilities of tenants should be given on the back of the *khahaas* which they receive where a record-of-rights is being prepared. This would bring home to them a knowledge of their rights to make improvements, but the proposal was not accepted, because I believe it was feared that the abstract might mislead or unsettle the tenants. I still think this ought to be done.

45. *Q.* (*Mr. Rajaratna Mudaliar.*)—Mr. Milne and Ram Narain Singh both very strongly urged that the registration under section 33 of the Bengal Tenancy Act for improvement are very stringent, and that it is practically impossible for zamindars to establish a claim for enhanced rent?—This registration presents no difficulty in their way; the only necessity which exists under this Act is of having an improvement registered.

46 *Q.* That is the difficulty which, we are told, prevents the enhancement of rent?—Here are the sections 33, 80 and 81. (Reads.) There is nothing to prevent a landlord from having his improvement registered An application to register an improvement can be refused, after inquiry, only by the District Collector himself under the rules in Chapter III of the Tenancy Act Rules. The Collector is not likely to refuse registration or to place difficulty in the way where the improvement is a real one.

47. *Q* (*Mr. Muir-Mackenzie.*)—Do you think that there may be any objection on the ground that the disrepair, which the so-called improvement set right, was due to previous neglect on the part of the landlord, and that the improvement was only a fulfilment of a neglected duty?—That difficulty may arise perhaps in Gya, but it does not arise throughout the country generally. And in places like Gya where a landlord is by custom bound to keep up these works, whether it would be an improvement to merely spend money on doing what he is bound to do and whether a rayat is bound to pay enhanced rent on that account, is a question of fact which might be tried in the Civil Court. I should not like to say positively. The difficulty does not arise throughout the country generally. The case of Gya is a special case. Moreover, even if a Collector were to refuse registration under section 81 of the Tenancy Act, landlords and tenants can have evidence recorded of any improvement alleged to have been made. The evidence must be recorded in accordance with the provisions of sections 182 and 184 of the Civil Procedure Code, the record is admissible in evidence in any suit or procedure between the landlord and tenant (section 81 of the Act and rule 7 of Chapter III of the Tenancy Act).

48. *Q.* Are improvements registered by landlords?—Not generally, because they do not very often make them. They are very often ignorant and go on according to the custom of the country. But many improvements have been registered and the number of registration is increasing.

49. *Q.* You would not like to see the Collector given the power of enhancing the rent instead of the Civil Court? — Not generally. Revenue Court formerly tried all rent suits and the system was deliberately abandoned.

50. *Q.* The zamindar would prefer it?—The Collector might perhaps give a larger enhancement than the Civil Courts, and proprietors would naturally like facilities for enhancement; but yet when the Bengal Tenancy Act was being amended in 1898, the British Indian Association representing the zamindars preferred that enhancements of rent in the permanently settled areas should be left to the Civil Courts and not transferred to the Revenue Authorities

51. *Q.* In determining the nature of the improvement, do not you think the Revenue Officer with all his experience is likely to do it more satisfactorily?—The Collector now determines the nature of an improvement, *i e.*, whether any work is an improvement or not. I think there is a great deal to be said for the view that, in the case of enhancement on the ground of improvements, the Collector and Revenue Authorities are better qualified to judge what is an improvement and how far enhancement of rent is justifiable on that ground; but as to enhancement of rent generally on other grounds, I should prefer the Civil Court. It is to be observed that Collectors have, under the rules in Chapter III of the Tenancy Act Rules, to decide what is and what is not an improvement before they register it and to record evidence of improvements.

52. *Q.* In Bombay landlords get larger enhancements in Civil Court?—Here on whichever side you put the burden of proof, that side loses by going to the Civil Court. In the case of Revenue Authorities proof is not so difficult The Collector or Revenue Authority may go to the spot and ascertain the fact. I may mention an instance of how improvements are impeded by ignorance of rayats and how sometimes difficulties are placed in the way by landlords. In the Darbhanga Raj when I was making the settlement there in 1876 there was scarcity and relief works were started, and the rayats of some villages came to me and said that they wanted permission to make tanks and I gladly gave them permission to make these tanks as relief works; but I found that the custom had been before a rayat was allowed to dig a tank that he should execute a written agreement to pay Rs 250 *salami*, and continue to pay the rent of the land and to be in no way entitled to the fish or other produce of the tank. I put a stop to this state of things, and the result was that in one pargana in that year of distress, there were no less than 54 tanks, made by head rayats at their own expense, and the Darbhanga Raj had to pay nothing for these tanks That illustrates to my mind that much can be done by encouraging rayats to make tanks and wells for the improvement of their holdings by informing them of what their rights are, and by seeing that illegal obstacles are not placed in their way.

53. *Q.* You mention want of capital as one of the difficulties. Would not that be remedied by improving the system of taking advances?—Yes.

54. *Q.* At the present moment the amount of advances is very small?—Yes, I think that avoidable difficulties are placed in the way of people taking loans under the Land Improvement Act. In the matter of making budget provisions for loans the Collector has before August of the current year to make out an estimate of his requirements of the following year. It is difficult for Collectors to foresee what their requirements will be so far a head, and, as a rule, they estimate for very little. Then if during the following year a rayat or zamindar comes to the Collector to take a loan, if he has not made budget provision the result is that the landlord or rayat does not get the loan and goes off to the bania and gets it from him. But assuming that budget provision has been made, the applicant has to come under the existing rules three times to the Collector's office before he gets the money An honest and industrious rayat hates going to the Collector's office far away from his village. He does not know the ways of the place and he is plundered by the *amlas* and the people round the Court and he is kept hanging about the Court for several days. All that naturally interferes with his inclination to take an advance. All this may perhaps be remedied by authorising Collectors to spend every year a certain sum of money which may be provided for in the budget of every district and by also authorising Collector and Sub-divisional Officers and other Revenue Officers to make inquiries themselves, and whenever they see that there is any work of improvement, whether a well or a tank, that is likely to be profitable, to tell the people concerned that they have money and are willing to advance it there and then on adequate security. If some such scheme were adopted, I think it is likely that the rayats of Bengal may in time execute improvement on a very much greater scale than has ever been thought of.

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55. *Q.* There is a precedent for this practice which is adopted in the Opium Department?—Yes, and the result is that the Opium Officers have advanced large sums for wells on land suitable for opium. I think their services should be employed for making advances for all other kinds of improvements and not alone for irrigation of opium lands. I understand that Opium Officers have very little to do for considerable periods of the year, and I would suggest that their services should be utilised in working out schemes for wells and tanks, and in making these advances.

56. *Q.* Could not the Subdivisional Officers do this?—Yes, so far as other duties permit, but one difficulty Collectors and Subdivisional Officers have is this that, although they are all anxious to introduce improvements, they are hampered by want of establishments and by other works. I certainly think that it would be better to have special officers in every district if possible to examine the district and see what could be done in the way of encouragement of irrigation and other improvements.

57. *Q.* With regard to the budget provision, would you recommend that the Collector should have for so many years a certain fixed sum placed at his disposal from which he could make loans without any of the delays and the trouble that at present arises, and further that he should report every year to the Board of Revenue why it is that he has not been able to spend the money, and that he should be encouraged to spend that money on useful schemes?—Yes, if possible.

58. *Q.* You would have careful inquiries made as to the work on which he is going to spend money, and that he should, while on tour, make the necessary inquiries regarding security?—Yes, personally and by means of subordinates.

59. *Q.* Would it not also be necessary to have some agency to inspect the work to make sure that the money was properly appropriated?—Yes.

60. *Q.* He should give the money out by instalments and inspect the work each time, before he gave more?—Yes.

61. *Q.* Do you think it desirable to have a record-of-rights in water?—I think that in areas like Gya and other parts where disputes arise about water or the custom regarding the distribution of water, it is very desirable indeed that the existing custom should be ascertained and recorded, and where disputes arise that an agency should be provided for settling these disputes. When I was Revenue Secretary orders were, I think, given that the rights of villagers in the *pains* and in reservoirs of Gya with regard to the distribution of water should be recorded in the record-of-rights, and that where disputes arose they should be settled by the Revenue Officers whose decisions of disputes have the force and effect of a Civil Court decree. When any dispute arises in making a survey and record-of-rights in permanently settled areas, the Revenue Officer is bound to decide the dispute and his decision has the force of a decree; and that applies just as much to rights and customs regarding water as to any other conditions of the holding. Where there are no disputes or where a record-of-rights is not being prepared, I do not think it would be worth while to take up the question and make a record-of-rights in water.

62. *Q.* Where rights are complicated and lead to disputes you think these rights should be framed?—Yes, where a record-of-rights is being made, Revenue Officers should record the customs and rights of the people in water just in the same way as they record other rights and customs.

63. *Q.* In the Gya district it was suggested that we should give the Collector power to make landlords keep their *pains, bunds* and *ahars*, in a state of repair. It was proposed that he should give notice to the landlords to make repairs when the works were found in a bad state, and that if the landlords failed to do so, the Collectors should have the power to carry out the work and charge it to the landlord. It seems a strong measure?—As regards Bengal and Bihar generally, I do not consider that any such measure is required, but whether in places like Gya, where people have to combine to make and maintain irrigation works, it would be desirable to give the Collector such powers is a question on which I should not like to offer an opinion without local inquiry and more knowledge of the facts than I possess.

64. *Q.* With regard to wells, do you think that in certain parts of the provinces there is room for considerable extension of well-irrigation?—Yes.

65. *Q.* In all the places where the soil is suitable and water within a reasonable distance?—I consider that there is very great room for extension of well-irrigation, especially in Bihar. In the Sitamarhi Subdivision of Muzaffarpur, when the scarcity of 1896-97 began, I found that the people there were digging *kachcha* wells, and that they had water within 6 or 7 feet of the surface while the crops on the surface were dying of drought. The Bengal Government offered certain inducements to the rayats to dig *kachcha* wells, and they were then made on a large scale in that Subdivision only, but I consider that enough was not done in other parts of Bihar, and that this system might have been extended to other parts in that year as a mere temporary measure. As I found in that year of great drought and famine in that large Subdivision, that there was water within 6 feet of surface, it seems to me that there must be room for the extension of wells in that part of the country. In Lower Bengal, on the other hand, I do not think much can be done in the way of making wells for irrigating rice, but in some parts of Nuddia tract, which I have mentioned as a famine tract, I should think from the nature of the soil that wells might be introduced there.

66. *Q.* You would not despair of training the people?—I would not despair of training the people to do anything that is to their own interests to do. If they were trained to make wells and having made them they found that the result was beneficial, I think that they would adopt well-irrigation.

67. *Q.* Have you ever tried bringing cultivators from other parts of the country where well-irrigation has been done?—I have not personally tried this, but I think it has been tried by the Agricultural Department.

68. *Q.* With any effect?—I cannot say. Mr. Allen will be able to tell you.

69. *Q.* (*Mr. Rajaratna Mudaliar.*)—Would legislation be necessary to prepare record-of-rights in water?—No.

70. *Q.* You think sections 101 and 102 of the Bengal Tenancy Act contemplate it?—Yes.

71. *Q.* They only relate to the incidents connected with land. There is nothing about rights in water. I do not think this section applies?—Yes; the section says the Revenue Officer is to record the incidents of every tenancy and any other particulars the Local Government may direct; I think the right to water for irrigation of a holding from wells, tanks or other sources, where it exists, is an important incident of the tenancy.

72. *Q.* Has that been accepted by the Legal Officers of the Government?—I do not think the difficulty has ever arisen. I have not heard the question ever raised. I don't think that the question has ever been raised in the Civil Courts or before Revenue Officers. It seems to me manifest that the customs and rights of tenants to water for irrigation, or the non-existence of such rights, as the case may be, are important incidents and conditions of their tenancies.

The Honourable Mr. J. A. BOURDILLON, C.S.I., Member, Board of Revenue.

(*Calcutta, 8th November 1902.*)

J. Bourdill

1. *Q.* (*The President.*)—With what part of the province are you best acquainted?—With the Patna Division and Bihar generally.

2. *Q.* We should like to have your opinion about the Saran Canals. Our inquiries show that the people there are very anxious to have irrigation?—The planters, the Collector, Mr. Hare, the Commissioner and others were all in favour of improving the canals, and I do not think that, from a technical point of view, there is any real obstacle. It is very much a matter of money. The canals are essentially faulty in system, and without considerable expenditure of money they could not be put to much practical use. The question is whether it is worth while spending the money.

3. *Q.* Securing any return for the expenditure appears to be the main difficulty; all our witnesses in Bihar, from the Collector downwards, were of opinion that, if the canals were improved, the benefits would be so great that it would be fair to impose a cess of ¼ anna in the rupee of land revenue, in the same way as the embankment cess is levied in Saran. Mr. Macgregor said that the people were actually clamorous for irrigation. In Purulia we examined Mr. Slacke, formerly Collector of Saran, who was very emphatically opposed to the scheme. Yesterday we examined Mr. W. C. Macpherson, also a former Collector of Saran, and his opinion was very much the same as that of Mr. Slacke. There is thus this great diversity of opinion. We would like to know your view on the subject?—I am inclined to support Mr. Macpherson and Mr. Slacke. I cannot admit the fairness of imposing

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an irrigation cess upon the whole district in order to benefit practically only a part of it. It is perfectly true that Saran would benefit in a general way by there being no famine, just as the whole province would benefit; but beyond this general advantage I do not see why more than half this district, which would get nothing whatever from irrigation, should have to pay for it. As far as I can remember, Saran contains 1,712 square miles, or 1,095,680 acres, and according to Colonel Haig's estimates, not more than 100,000 acres would be commanded by the canals. Saran practically requires irrigation less than any other district in North Bihar, because it is a three-crop district. Whenever we have a famine in Bihar it comes from failure of the winter rice crop. But rice is not by any means so important a crop as it is elsewhere. *Rabi* is the most important, representing 40 per cent., and then comes *bhadoi* with 32 per cent., and, lastly, the *aghani* rice with 28 per cent. These are the figures which were available at the time of the famine in 1896-97; they have been altered somewhat since in the Settlement Report, but the general proportion remains the same. Then, again, the cost of making these canals really effective would be very great. At present they are only a combination of drainage channels and low-level canals, and are consequently most difficult to work. They have, as far as I know, never been properly surveyed and levelled, and are essentially low-level canals. Besides this they suffer from the serious disadvantage that the water-supply at the head is extremely precarious. The water is taken from the Rupanchap *sota*, which is liable to be closed at any time by the shifting of the river or the silting up of the mouth of the channel itself. In the face of such a danger no one would spend money on these canals without much hesitation and fuller proof that they are absolutely required.

4. *Q*. It would be too costly to take the water from the Gandak itself?—Yes.

5. *Q*. The canals as they now are have always been a failure?—In my judgment the scheme was a crude and incomplete scheme when started, and it has never been well worked. It was essentially a scheme for providing water at all times and in all years for the manufacture and irrigation of indigo, and the irrigation of food crops was a secondary consideration. Now that indigo has failed so greatly, more water would probably be available for the irrigation of other crops, but the interest of indigo planters, who were the promoters of the scheme, would necessarily be smaller.

6. *Q*. We heard the evidence of Mr. Ogilvy, Manager of Hatwa Estate, who was anxious for two more sluices further up. He said that they would bring in the whole of this estate within the irrigable area?—Yes. He must have been speaking of the Daha; this is only one of the four rivers or canals. It takes off from the Rupanchap *sota* higher up than the others, and therefore it is the best in point of position.

7. *Q*. He also mentioned another stream which might be used—the Jharai?—That comes from far away and has nothing to do with the Saran Canal system; it rises, or takes off, from the Gandak in Gorakhpur and not in Saran.

8. *Q*. To change the subject: we have considered a number of canal schemes for the northern part of Champaran, and almost everywhere we have been brought face to face with the difficulty that the Nepalese might cut off the supply of water. That difficulty seems insurmountable?—It is an immense and ever-present difficulty which has always been felt, and applies to practically all the hill streams, except the great rivers.

9. *Q*. On that account we were impressed with the importance of the Triboni scheme, and we are writing to the Government of Bengal, suggesting that the masonry works might be made on a larger scale so as to allow of the future extension of the schemes. There is one river, we are told, we might rely upon, and that is the Kamla, which, it was said, was so big that it could not be bunded up?—Yes. There is also the Bagmati which is another large river.

10. *Q*. The Bagmati scheme hardly recommends itself to us?—When I was Commissioner I reported against it, because the scheme is not really required and would be very expensive. Next, there is the question of the Eden Canal. I suppose it was not intended in the Burdwan Division for famine protection, but that in this part irrigation is highly prized?—Yes. It took a long time for the canal to become popular, but the people have gradually come to realize its value. If I remember right, when I was Commissioner of Burdwan, we had a system of leases for 3 and 7 years, and sometimes it happened that, during the period of lease, irrigation would be required only once. It took a long time for the idea to soak into the popular mind, but at last they did realize that the lease was a useful insurance. On the Sone Canals the rayat learnt the lesson faster. The extension of the Eden Canal is out of the question. I believe, unless you have a weir across the Damuda; but this is outside of the area requiring protection against famine. That is so.

11. *Q*. With regard to the Sone Canal, we had strong evidence of the necessity and demand for irrigation in the Bhabua Subdivision. There is a memorandum on record, prepared by Mr. H. C. Levinge, formerly Superintending Engineer, showing that there are great storage possibilities on the Kaimur plateau?—I think it is very important that irrigation should be extended to Bhabua; it is the only part of Shahabad which is not irrigated. The Commission are no doubt aware that it was intended to irrigate Bhabua from the Sone. The great western canal is down on the maps, but the works have never been carried out, because it was found that it would be impossible to fill them. The Engineers have been disappointed with the amount of water which they can get from the Sone. It is with the greatest difficulty that, in times of scanty rainfall, they can fill the existing canal with water.

12. *Q*. We are anxious to know particulars with regard to the revenue derived from the Sone Canals; the interest paid on the capital; how much of that capital is due to navigation and how much to the work of the canals. Mr. Horn's idea is that the estimate might have been cut down quite 20 per cent., because the canals are absolutely valueless for navigation?—Certainly; the navigation receipts are quite trifling.

13. *Q*. It is hardly fair to debit the irrigation scheme with that part of it?—No.

14. *Q*. Do you think highly of the Tribeni scheme?—I am a very strong supporter of it, and have been all along.

15. *Q*. We find generally a great deal of indifference with regard to well-irrigation. In some districts we are told that the people will not take to well-irrigation, especially in Chota Nagpur?—Wells are pretty well known and used in Bihar, especially in Saran, and in the country all round Patna, where there is a great deal of garden produce. Where you have good cultivators, they go in for wells and ask for small loans. They do not work small wells so much by bullocks as by levers. In 1896-97 Mr. Finucane was Famine Secretary. He was very anxious that advances should be given for making *kachcha* wells all over the division; but no district took advantage of them to any extent except Muzaffarpur; elsewhere they were entirely rejected. What the people said in excuse was that they did not like well water for irrigation, because it was too cold, and that when once you irrigate any land from wells it must always be irrigated from wells.

16. *Q*. I wish to ask one or two questions about the famine programmes. Would you tell me what kind of works were principally executed during the last famine?—Mostly roads and tanks. Tanks predominated in Champaran, and roads elsewhere. Out of 901 works undertaken during the period of scarcity, 404 were tanks, 416 roads and 81 neither the one nor the other, being mostly sections of railways or canals.

17. *Q*. What was your opinion with regard to their general utility?—I think that almost, without exception, they were extremely useful. I believe our works will be always useful.

18. *Q*. We had some evidence from Bihar to the effect that roads were made in areas where they are not wanted?—Where there is such a dense population as in Bihar, a road is always an advantage, but there is sometimes the difficulty and expense of keeping them up and maintaining them, if they are made of a pretentious character.

19. *Q*. We have been told that the districts had quite sufficient roads?—I do not agree with that. I believe that every road that was made was an improvement.

20. *Q*. With regard to the tanks, were they all useful for irrigation?—Their main object was not always for irrigation, but mostly the supply of water for cattle and for general convenience, and, to a subsidiary extent, for irrigation.

21. *Q*. You consider these tanks to have been works of great utility?—Not of the very first class of utility, perhaps, but still they are very useful.

22. *Q*. They have great advantages as works for supplying relief work?—Yes, a large number of workers can be concentrated in one place, and you can easily control them.

23. *Q*. Would you not rather see them replaced by works more useful for irrigation in the shape of canals?—Yes, if

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it could be done, but comparatively few of these can be devised and carried out in Bihar.

24. *Q.* Would you be in favour of making these *pains* for relief works? After having the country very carefully surveyed and ascertaining the possibility of making cuts and *pains*, would you object to providing them as famine works and wells also?—I have no objection to that.

25. *Q.* You only go so far as to say "there is no objection." You do not say that it is very desirable?—It is desirable; but there is always the difficulty of acquiring land and rights in water. There is no difficulty as regards tanks. The zamindar gives the land, and he makes arrangements with the tenants about the water and the fishing.

26. *Q.* Is there any chance of his giving land for the *pain*?—The *pain* would probably run through several villages, each of which would probably be the property of many landowners, and it would be very difficult to get all the proprietors to agree together to give the land; this combination would be absolutely necessary before you make it. As District Officer, I have often tried to make cuts and channels; but I have always failed by not being able to get all the parties to agree. Of course it may be done by Government acquiring the land, but as an individual officer I was foiled again and again.

27. *Q.* I suppose Mr. King was confronted with this difficulty?—No, I think not, because all the lands in which his channels were constructed were in villages which belonged wholly, or in great part, to his employer, the Maharaja of Darbhanga.

28. *Q.* It is hardly necessary to ask how famine programmes are prepared. We got that from Mr. Macpherson?—I have not seen one for four years, *i.e.*, since I left the Patna Division. The Board have had nothing to do with famine work since the Orissa famine of 1866, after which they were relieved of all famine duties.

29. *Q.* As Commissioner you prepare all famine programmes?—No. They are prepared by District Officers, but the famine programme comes to the Commissioner for criticism and examination, and is finally approved by him before it goes on to Government.

30. *Q.* You think there is sufficient time to prepare them?—My experience is that they are never ready. We were taken unawares in 1896-97, and so we shall be again, unless special efforts are made to prevent it. When I was Chief Secretary, I was constantly urging the importance of famine programmes and of having them ready. District Officers and District Engineers do not sufficiently realize their importance. After seeing, while on the Famine Commission, how other provinces were caught unawares in 1899-1900, I have tried to do all that was possible to guard against a similar failure in Bengal. It is impossible to pay too much attention to this subject.

31. *Q.* You would have complete plans and estimates?—Not for the smaller works; but I would for all the larger ones, and as to the smaller ones, I would specify that such and such a work should be carried out in or near such and such a village.

32. *Q.* Sometimes you find in particular villages very great difficulty in finding works of utility?—Tanks are useful almost everywhere where the population is very dense, and old tanks can be cleaned or deepened, or new tanks dug. If you do not get a suitable work in one village, you get it in another. These tanks are useful not so much for irrigation, but for cattle; *ex hypothesi*, when there is a failure of the rains, the tanks are generally dry, and little irrigation is possible. Few of them contain springs.

33. *Q.* (*Mr. Muir-Mackenzie.*)—I would like to ask you one or two questions about *takavi* advances. Hitherto the loans advanced in years of famine have been of very small amount; what is the reason?—I think the explanation is the same in most provinces. The people do not like to become the creditors of the Government for two reasons. First of all, the Government is very punctual in exacting payment. Secondly, I do not think so many advantages are given as might be done in the way of distributing the advances. Applicants have to come several times to head-quarters to settle matters, and they have to run the gauntlet of a whole series of underlings. It is more their custom, if they want money for any purpose, to get it from their own local *mahajan*. They pay more interest, but they get it more easily; payments are more elastic and renewals are possible.

34. *Q.* Do they borrow for agricultural improvements?—No, not much for purposes of large improvements, but when they do they go to him.

35. *Q.* For wells?—For wells also.

36. *Q.* Do you think that *takavi* advances should be given on a much larger scale in the provinces?—I think they should. The expansion would take time. It would require to be pushed by particular men. The personal equation is very important in this matter.

37. *Q.* Would you be glad to see it pushed?—I would for wells especially.

38. *Q.* Do you think there would be any difficulty on account of security in giving advances to the tenant class?—I don't see why there should be any. In the part of the country that I know best a large proportion of the tenants have occupancy rights, and I do not see why there should be much difficulty.

39. *Q.* Do they mortgage their holdings; do they give *salami*?—The answer is "yes" to both these questions.

40. *Q.* Do you think that, as a matter of fact, the landowners would be willing to give up *salami*?—Not willingly; the Maharaja of Hatwa always took *salami*. He would not give wood for the well-kerb, nor would he allow a tree to be cut down for burning bricks, till he had received his *salami*.

41. *Q.* Do you think that could be overcome?—It was overcome in the Hatwa Raj. Mr. Tytler of the Opium Department had great influence with both tenants and landlords, and he used his influence to such good effect that he managed to persuade the Maharaja and others to waive part of their claims. By means of personal influence some of these difficulties can be got over.

42. *Q.* Even where the record-of-rights has not been prepared, the rayat understands his position sufficiently well?—There would always be much ignorance; but I believe that everywhere the tenant is learning to know how far he can go and how far the landlord can raise his rent.

43. *Q.* Do you think that it is not possible to make them better informed?—Yes, by the efflux of time they will learn their rights.

44. *Q.* Do Revenue Officers go about and tell them what their rights are?—When they do, the result is not always what they expected. I would not advocate a man going about preaching propaganda of this kind. The record-of-rights informs them all of what their rights are. As it is prepared, it teaches them their rights, but in a slow, dignified fashion.

45. *Q.* Does the record-of-rights, as at present framed, embrace any rights in water?—I don't think so.

46. *Q.* I understood from Mr. Finucane that orders were given that a record-of-rights in water should be embodied in the Tikari Raj survey?—It may be so, but the matter never came to my notice.

47. *Q.* Would you advocate the preparation of a record-of-rights in water?—If they could be reasonably ascertained, I would.

48. *Q.* Do you think they would be difficult to ascertain?—They could be ascertained, no doubt, by inquiry.

49. *Q.* If they were ascertained and a record made by the Collector, do you think he should have power to enforce the observance of these rights? Do you think that the Collector should be given this power?—I think so. I would rather that the Collector had it than the Civil Court.

50. *Q.* We have had a representation on the part of some zamindars in Bihar that landlords had some difficulty in obtaining enhancement of rent for improvements made by them in spite of the provisions of the law. Do you believe that to be the case?—I cannot remember having heard of a case of the kind. I do not think one has come to my notice hitherto.

51. *Q.* Do many landlords apply to have improvements registered?—In the Patna Division one landlord, the Maharaja of Hatwa, made a great many applications, but for the most part few improvements are registered.

52. *Q.* Did these applications involve criticisms as to whether they were improvements or not?—Everyone of them was inquired into.

53. *Q.* Were applications ever rejected on the ground that it was the business of the zamindar to keep the works in repair, and that he was only performing a duty and that it could not therefore be called an improvement?—Yes, I think 10 per cent. of the applications were rejected on that sort of ground. In other cases of unsuccessful applications the ground of rejection was that the improvement was a small matter and not worth registering.

54. *Q.* When an improvement has been registered and the landlord finds that the tenant objects to pay enhanced rent, he has to go to the Civil Court. Would he prefer

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that he should get his enhanced rent from the Collector? The Collector has registered the improvements; he knows all about the facts, and it seems a certain waste of time to go to the Civil Court?—This would be a fresh departure from the established custom, because all those enhancement cases have to be brought not into the Revenue but into the Civil Court. It would be a departure, but I daresay that the Revenue Courts would do it much more quickly.

55. *Q.* You don't think that this would greatly encourage zamindars to get enhancement of rent?—I don't know that they take that possibility much into their consideration, nor do I think that it would affect their action.

56. *Q.* When they make an improvement, do they get tenants to make contracts for higher rent?—Yes, this is done. It was done a great deal in the particular case which I have mentioned.

57. *Q.* A landlord really desirous to make improvements, like the Maharaja of Hatwa, would make contracts with all his tenants?—I believe not formal contracts with all. It would often be a matter of vested arrangement.

58. *Q.* With regard to the tenant, who by law is protected from enhancement on account of improvements made by himself, do you think that, as a matter of fact, that law is got round?—Very possibly it is. I cannot speak from experience.

59. *Q.* Can you give us any idea as to how much money was spent in the famine of 1896-97 on works that are useful for irrigation?—I cannot say this off-hand, but I can look into the district reports and let you know, if required.

60. *Q.* But more is spent on other relief works?—We again come back to what I said about the density of population in Bihar; that dense population makes it reasonable to carry out works which do not lead up to irrigation, such as roads and non-irrigation tanks. It might not be reasonable in a more thinly populated province.

61. *Q.* (*Mr. Rajaratna Mudaliar.*)—With regard to the granting of loans, is there any difficulty in the matter of security?—There certainly is very often. Where there has been a survey and record-of-rights, there would not be very much. Before the survey came up to Bihār we had great difficulty in finding out about security. The Collector had to be very careful. Inquiries were made locally in all cases, but even so he was sometimes deceived.

62. *Q.* As regards previous mortgages, could you not find it out from the registration records?—We did so, but we were sometimes deceived.

63. *Q.* In the Madras Presidency, in every case before a loan is granted, the Collector takes an encumbrance certificate from the Registration Office. If that were to be done, there would be no difficulty?—That was done as far as possible, but still there was difficulty. In Saran and other districts, where there are non-official Europeans, we generally get help from the planters. Of course their knowledge is not very extensive, but they would be able to give information regarding the financial condition of men in their own villages.

64. *Q.* (*Mr. Allen.*)—I would like to ask you one or two questions about the Land Improvements Act. The rules under this Act do not provide that applications to the Collector may be made over to the Subdivisional Officer to grant advances. Do you think that the rules should be amended to provide powers of this kind?—I have no objection at all.

65. *Q.* And should these loans be vigorously pushed?—Yes; I should like them pushed. More can be done than is done at present.

66. *Q.* The preparation of estimates of expenditure under the Land Improvements Act is apparently conducted in a very formal way, and the result is not satisfactory?—One reason is that in most districts there are very few applications. The figures for one year will serve for any future years.

67. *Q.* If these loans were vigorously pushed, the total expenditure of the province would very much exceed the present expenditure?—No doubt it would.

68. *Q.* You are of opinion that the Collectors ought to be urged to push the grant of these loans in a more vigorous manner?—I certainly think so.

Babu Jamini Mohun Das.

Babu JAMINI MOHUN DAS, Deputy Collector, Cuttack.

(*Cuttack, 11th November 1902.*)

1. *Q.* (*The President.*)—You are Settlement Officer here?—I was Assistant Settlement Officer, but now I am employed on general duty in Cuttack.

2. *Q.* Were you here all the time the settlement was making?—I joined the settlement in October 1892 and I remained on till the end of the operation.

3. *Q* About eight years?—Nearly eight years.

4. *Q.* You were with Mr. Maddox?—Yes, he was Settlement Officer.

5. *Q.* You were here during 1896-97?—Yes.

6. *Q.* Was the scarcity much felt at that time?—There was a little distress; it was not much felt in Cuttack.

7. *Q.* Were there any relief works started?—There were no relief works in the part where I was on settlement duty.

8. *Q.* Did the prices not get very high?—The prices did get fairly high, but that did not cause much distress.

9. *Q.* There was a complete failure of the rain in August; was there not?—The rain ceased abruptly in September in the early part, and there was no rain from the date when it ceased in September to the end of October and also to the beginning of November.

10. *Q.* About what time in September did it fail?—During the first half of the month.

11. *Q.* What districts were you in?—In the Cuttack district.

12. *Q.* Have you had anything to do with Puri or Balasore?—No, I have seen a portion of Balasore and also a portion of Puri.

13. *Q.* Cuttack is well protected by irrigation?—It is very well protected. I don't think there will be any famine or any severe scarcity in Cuttack.

14. *Q.* Puri and Bhadrak have no irrigation?—In Bhadrak there is a little irrigation; Puri has none.

15. *Q.* Do you think in the year 1896-97 that the people were much better off in Cuttack than in Puri and Balasore?—I think they were very much better off in Cuttack than in Puri. There was some relief in Puri, but none in Cuttack or Balasore.

16. *Q.* Do you think there is any likelihood of there being a famine here again in the way there was in 1865-66?—I don't think there will be any famine here and that is due entirely to the irrigation works.

17. *Q.* I suppose you consider that the railway would have something to do with it in future?—Certainly. Railways are taking more labouring people to Calcutta, and the opening of the steamers has played an important part in respect of the condition of the people.

18. *Q.* When did the steamers begin about here?—It was about the time when the irrigation works were also opened.

19. *Q.* I remember the steamers running from Chandbally, 24 years ago, in 1878?—I think it was opened much before that.

20. *Q.* Don't you think that the railway coming in here helps to bring produce into the country and keeps the prices down?—Yes.

21. *Q.* Supposing there were no canals in Orissa and that there was merely a railway and these steamers, do you think you could have a famine there then?—I think so. About 200,000 acres of crops are protected by irrigation; the loss of crops in these 200,000 acres would be very large.

22. *Q.* Do you think here that the people are ready to take leases?—They are not always very ready to take leases; they are very ready in years of drought.

23. *Q.* Are they allowed to irrigate without leases, or are they obliged to have leases?—They are not allowed to irrigate without leases.

24. *Q.* They cannot pay for just one season?—They are not allowed now at the usual rates. That is my impression.

25. *Q.* And do you think if there was much more water that there would be a greater extension of irrigation?—That depends on the level of the water. Of course high lands cannot be irrigated.

26. *Q.* Supposing there were more canals, would they use all the water you could give them?—I think that would be the case.

27. *Q.* There is no well-irrigation, I understand?—No. The people are very much prejudiced against well-irrigation.

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They say well water injures the paddy crop. Rice is practically the only crop irrigated here.

28. *Q.* I saw coming along the railway patches of sugarcane cultivation. Is that not irrigated at all?—Sugarcane depends entirely on irrigation, but the area under sugarcane irrigated from Government canals is very small. It is chiefly irrigated from private sources.

29. *Q.* And what are these private sources?—The bunding up of small water-courses, the raising of water from river-beds, and so on.

30. *Q.* Tanks?—Sometimes also from tanks. Tanks are very much used for irrigating rice when the rain fails in September or October.

31. *Q.* But they must be very soon exhausted?—They are very soon exhausted, so the area they can protect in that way is very small. I don't think they can protect in that way more than two annas of the crop.

32. *Q.* Is there much use made of the boats, or of navigation on the canals?—Not much. The chief means of transport in Orissa are pack bullocks.

33. *Q.* Then there are roads always?—Yes.

34. *Q.* Is that throughout the whole of Orissa?—In Cuttack and Balasore I find that is the case, and even when they can get canal water to put boats on, they very seldom use the boats.

35. *Q.* What is the reason for that?—This is a province in which boats are very little used.

36. *Q.* These large rivers get boats on them; don't they?—Not many.

37. *Q.* It must be cheaper to use boats?—On the whole it is cheaper, but in the rivers they cannot use the boats throughout the year. The currents become too strong during the floods, while in dry weather the rivers dry up.

38. *Q.* Then you don't think the canals are very much good for navigation?—Not much good at present. I don't think the people will take very much to navigation.

39. *Q.* Do the agriculturists take *takavi* advances for any purposes in this province?—They generally take loans for paying the revenue, especially at this *kist* in November.

40. *Q.* That is not from Government?—No.

41. *Q.* Do they get *takavi* advances from the Collectors?—Very seldom.

42. *Q.* It would be cheaper to get it from the Collectors than from the *bania*; would it not?—They don't like taking loans from Government, because the dates of payment are very exact.

43. *Q.* And they have got to pay them?—Yes.

44. *Q.* (*Sir Thomas Higham.*)—You were on the settlement of which districts?—Cuttack District.

45. *Q.* Only?—Yes.

46. *Q.* That included the canal area and the rice district?—Yes.

47. *Q.* How much of the land here is under permanent settlement and how much under temporary settlement? What is the proportion?—I can give it from the Settlement Report. The total area of the district is 3,663 square miles, of which 1,484 square miles are permanently settled.

48. *Q.* That is one-third?—A little over one-third.

49. *Q.* The rest is all temporarily settled. Is this permanent area in the canal area?—There is a very small canal area. I don't think the area irrigated from the canals exceeds 20,000 acres in the permanent settled estates.

50. *Q.* On the temporarily settled areas will the assessment be enhanced now? Has any enhancement been proposed in consequence of the canals?—There are some rents which are not enhanceable during the currency of the settlement. The rents of occupancy rayats cannot be enhanced until 15 years after the date of the settlement, but there are some rents which cannot be enhanced at all during the currency of the settlement; they have been fixed for the settlement.

51. *Q.* In the temporarily settled lands is there any enhancement of assessment proposed in consequence of canal advantages?—We did not take irrigation as a basis for enhancement.

52. *Q.* Has not the irrigation improved the value of the land at all?—Yes, it has certainly.

53. *Q.* The irrigated lands are sure of water during drought?—Yes.

54. *Q.* They are protected to a certain extent from floods?—Yes.

55. *Q.* And they can carry away their produce by boats?—The distributaries are not navigable.

56. *Q.* But they can carry their grain down to the main channels and send it away; cannot they?—But they don't use boats for carrying produce.

57. *Q.* How do they carry the grain, then?—Either by carts or by bullocks.

58. *Q.* Then the canal has been very little used for that?—Very little used. It is scarcely ever used for carrying grain.

59. *Q.* (*Mr. Muir-Mackenzie.*)—I gather that the area that can be benefited by the canal does not exceed 300,000 acres?—Yes, and that is only about one-fourth of the cropped area of the district. The cropped area of the district is about 1,300,000 acres.

60. *Q.* What do you think ought to be done for the remaining ¾ of the district?—Of the remaining ¾ there are certain tracts which are now exposed to very severe floods. I think there should be a complete examination of these tracts, and there should be a report by the experts as to what should be done for protecting these areas from floods. There may be irrigation if there be sufficient sluices in the embankments, but the most important thing is protection from floods. Of course after the construction of these flood embankments the irrigation works should also be extended as much as possible.

61. *Q.* But the first thing they seem to want more urgently than even irrigation is protection from floods?—Yes.

62. *Q.* In the meantime is there anything less ambitious that can be done; do you think?—I think there may be extension of private works—tanks.

63. *Q.* Are there many tanks in any part of the district?—Not many, but even those which do exist are getting silted up.

64. *Q.* Do you think people could be induced to repair or improve their tanks if they were given advances from Government?—They are very apathetic. I don't think they will do anything themselves.

65. *Q.* You don't think they can be stimulated to do anything?—That may be tried.

66. *Q.* (*Mr. Rajaratna Mudaliar.*)—You said that the irrigational advantages were not taken into consideration in fixing your rents?—Yes.

67. *Q.* Why?—We generally left the existing rents of ordinary occupancy rayats as they were, because we considered the existing rents to be fairly high. In the case of certain tenants, however, who paid very low rents, we enhanced on other grounds. Our object in the case of low rents for ordinary occupancy holdings was to bring them up to the level of the existing "competition" rents.

68. *Q.* And what do you mean by "competition" rents?—That is, the rents paid by ordinary occupancy rayats, not the privileged rayats.

69. *Q.* Is the proportion of privileged rayats very high?—Not very high; it is rather low. Here there are some resumed *lakarajdars* (revenue-free-holders) and some *koridajamabundidars* (privileged tenure-holders paying low rents) whose rents are not liable to any enhancement during the term of settlement—30 years.

70. *Q.* In the case of occupancy tenants you can raise the rents at the end of 15 years?—Yes.

71. *Q.* Before the expiration of 15 years, supposing Government constructs a new canal, you cannot raise the rent?—I don't think there can be any enhancement within 15 years.

72. *Q.* I suppose you impose a water-rate?—On what?

73. *Q.* On these lands for irrigation supplied. Don't you do that?—Water-rates are levied by the Public Works Department for water supplied by that department.

74. *Q.* And your rents are irrespective of the water-rate?—Quite independent of the water-rate.

75. *Q.* In your settlements do you record any conditions as to the duty of the zamindars to keep their private tanks in repair?—There is nothing about the preservation of tanks for irrigation in the *kabulyats* taken from the zamindars.

76. *Q.* If they neglect the works of irrigation, the tenants have no remedy against them, I suppose?—Nothing by contract.

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77. *Q.* When was the settlement last revised in Cuttack?—The last settlement expired in 1304 *Amli.* The present settlement commenced from 1305 *Amli.*

78. *Q.* What was the increase as compared with former settlements?—A little over 50 per cent. for the whole province.

79. *Q.* For Cuttack?—It was a little more than that; about 54 per cent. The exact figures are contained in the Settlement Report. In Cuttack it was a little higher and in Puri a little lower.

80. *Q.* Is there much scope for constructing tanks?—By the tenants themselves?

81. *Q.* Either by the tenants or by the zamindars?—I don't think either the tenants or the zamindars will construct many tanks of their own motion.

82. *Q.* Is there scope for any Government action being taken?—The District Board might construct tanks; a few every year.

83. *Q.* But the District Boards have no funds?—The question of funds is the difficulty.

84. *Q* Would it not be worth the while of Government to take up the construction of these tanks?—By levying a cess?

85. *Q.* Yes?—But a cess will be very unpopular.

86. *Q.* But if the cess be very small?—I don't think the people will object if they see a few tanks constructed every year.

87. *Q.* (*Mr. Allen.*)—Did you make any inquiry about the difference in the rates of rents in irrigated and unirrigated areas?—We did make inquiries, but we could not find out exactly, because in almost every holding there are both irrigated and unirrigated areas, and the rents are often fixed in a lump for the entire holding.

88. *Q.* You were not able to trace any difference in the rates of rents?—We could not get papers from which we could trace this. I was sent to Dera Bisa to inquire about the effect of irrigation on rent rates, and I could not get any reliable papers from the landlords from which I could prove that the rates on lands irrigated from canal water are higher than the rates on lands not irrigated.

89. *Q.* But the canals were not made at the previous settlement; were they?—No.

90. *Q.* Then you compared the rates with the previous rates on both irrigated and unirrigated lands?—On temporarily settled estates.

91. *Q.* Temporarily settled estates are what I am speaking about. What was the result of your comparison?—There has been an increase everywhere.

92. *Q.* I don't think you quite understand me. One was irrigated and the other was unirrigated land, and you compared the rates on both. What was the result? Did you find a larger rise in the irrigated tract?—No appreciable difference was found.

93. *Q.* Then, as regards the work of collection, did you find any difference?—That is the case everywhere.

94. *Q.* What did you find?—Collections are much better in irrigated areas than in unirrigated areas, I think. The estimate of the Settlement Officer was 5 to 10 per cent better. That is the benefit derived by the zamindars.

95. *Q.* Do you know the Bundi estate?—No, I don't know anything about the Bundi estate.

UNITED PROVINCES.

Mr. J. Hooper.

Mr. J. Hooper, Commissioner, Allahabad Division.

(*Replies to questions for Revenue officers.*)

A.—General.

Q. 1.—The answers refer to the Province of Oudh. The earlier part of my service was passed in the districts of Sitapur, Unao, Gonda, and Bara Banki. Latterly I held the appointment of Settlement Commissioner for Oudh for two and-a-half years. I was afterwards Commissioner of the Fyzabad Division, and for a short time of Lucknow.

Q. 2.—The figures are given below for the different districts:—

District.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average annual rainfall.*
Kheri	0·99	0·76	0·48	0·21	1·20	6·74	12.02	13·56	8·19	1·34	0·16	0·39	46·04
Bahraich	0·88	0·70	0·45	0·35	1·46	6·00	12·99	11·50	7·97	1·61	0·12	0·30	41·39
Gonda	0·71	0·61	0·32	0·25	1·06	0·47	12·52	12·10	5·32	1·59	0·10	0·28	41·33
Sitapur	0·84	0·52	0·47	0·19	0·18	5·08	11·53	10·83	6·19	1·30	0·15	0·32	39·06
Hardoi	0·70	0·38	0·57	0·17	0·53	4·44	10·74	10·62	6·13	1·38	0·12	0·30	36·14
Unao	0·84	0·34	0·26	0·10	0·60	4·44	11·06	10·29	5·24	1·30	0·09	0·38	34·94
Lucknow	0·93	0·47	0·32	0·11	0·92	5·32	11·34	11·13	6·68	1·36	0·07	0·44	39·09
Bara Banki	0·82	0·35	0·39	0·15	0·92	5·25	11·18	9·96	8·31	1·11	0·07	0·47	39·01
Rae Bareli	0·66	0·41	0·23	0·09	0·37	5·31	10·97	11·04	7·51	1·31	0·12	0·24	38·26
Fyzabad	0·73	0·42	0·48	0·17	1·04	6·26	13·30	11·70	8·43	1·94	0·09	0·23	44·73
Sultanpur	0·72	0·44	0·22	0·17	0·61	6·21	12·43	11·49	7·59	2·18	0·16	0·23	42·45
Partabgarh . . .	0·78	0·40	0·10	0·04	0·43	5·05	11·59	11·11	7·03	2·27	0·21	0·50	39·62

Q. 3.—In some districts conditions of soil and climate, combined with sparsity of population and, in consequence, a backward state of agriculture, are unfavourable to the extension of irrigation. But in the greater part of Oudh it cannot be said the obstacles specified in the question exist. On the contrary, in the more populous and fully settled districts there has been remarkable progress in well construction during the currency of the settlements that have expired. This will be shown by the following figures taken from the reports in the recent revision of settlement:—

(1) *Rae Bareli.*—There are now 20,054 masonry wells for irrigation, of which 11,359 were constructed during the currency of the last settlement. There is now one well on an average to every 29 acres of cultivation.

(2) *Partabgarh.*—The number of masonry wells is now 15,522, which gives an average of one well to every 32 acres of cultivation. Considerably more than half of these are reported to have been made since the former settlement.

(3) *Sultanpur.*—There are now 16,453 masonry irrigation wells, an average of one to every 37 acres of cultivated land. Seven thousand six hundred and forty-one of these have been constructed during the currency of the expired settlement.

(4) *Bara Banki.*—There are 7,664 masonry wells (one to 89 acres of cultivation), of which 5,115 have been made since the former settlement. This district includes a considerable alluvial tract, and there are great facilities for making earthen wells.

(5) *Unao.*—The number of masonry irrigation wells has risen from 3,992 at the former settlement to 12,000 at the recent revision.

(6) *Fyzabad.*—In this district also there has been great progress in well construction, but the accuracy of the former returns is open to doubt, so that an exact comparison cannot be made.

Of the districts in which less progress has been made the first to be noted is Lucknow. Thirty-three per cent. of the cultivated area was returned as irrigated in the settlement year, but the supply of water largely depends on tanks and other natural sources. There are only 4,952 masonry irrigation wells, or one to every 70 acres of cultivation. The district is thickly populated, the average density, including the urban population, being 812 per square mile; the cultivation is good, though not of the very highest class, and the only reason I can suggest for the comparatively little progress that has been made in well construction, is that nearly half the area is owned by small proprietors, who are reported as a body to be involved in debt.

I take next the three northern districts—Kheri, Bahraich, and Gonda. Only six per cent. of the cultivated area is irrigated in Bahraich, and less than 10 per cent. in Kheri; in Gonda the proportion, though higher, is still low, amounting to 21 per cent. A brief account of the conditions in these districts will explain the reasons more clearly than a categorical answer to the questions put by the Commission.

In Kheri and Bahraich the population is comparatively sparse, averaging, respectively, only 305 and 398 per square mile according to the census of 1901. Grain rents prevail, with the usual result of inferior cultivation. When the population fills up, and the introduction of cash rents leads to more close and careful cultivation, more wells will doubtless be made, but only in certain portions of the district. The northern half of Kheri is a low-lying tract of *tarai*, intersected by rivers and flooded in the rains. Here wells are not required. In the southern half, of which about 20 per cent is irrigated, more wells might be made with advantage; but the average rainfall (46 inches) is the highest in Oudh, and in ordinary years good crops can be grown without artificial irrigation.

Similarly in Bahraich a very large portion of the area is alluvial land along the Gogra and the Rapti, which is naturally moist or *tarai*. The only part of the district in which wells could be made with advantage is the central upland plateau. But the district is favourably situated both for the autumn and winter rains, and there is little danger of drought. It has never suffered from famine, and even in the upland tract irrigation is rarely required. In one large estate, that of the Maharaja of Kapurthala, a number of expensive wells have been constructed by the proprietor, but they have hitherto been little used.

In Gonda, again, there is a large alluvial tract in the south, and *tarai* under the hills on the north. The central plateau is the only portion of the district where wells are necessary. It is at present insufficiently supplied. The

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cause is not sparsity of population, as the district density (498 per square mile), though moderate for Oudh, is fairly sufficient. I would attribute the backward condition of this tract to the fact that till recently some of the large estates in it were in the possession of proprietors involved in litigation and embarrassed with debt.

The two remaining districts are Sitapur and Hardoi, which lie in the western centre of Oudh.

In Sitapur the average irrigated area for the six years preceding the settlement was only 17 per cent. of the cultivated area, and there were only 1,735 masonry irrigation wells.

There is a large tract of flooded land in the east of the district, where wells are not wanted; while on the other side is a tract of *bhur*, or sandy soil, in which well irrigation would be scarcely practicable. It is in the loam tract in the centre that more wells are required. The obstacle to irrigation here is the general condition of the district, which is still backward, though rapidly improving. The density of the population, which was formerly low (477 per square mile), had risen at the census of 1901 to the sufficient figure of 533; but there has not been time for corresponding agricultural development. The rental system is in a transitional stage, and produce rents are still taken in a large portion of the area. As stable cash rents are introduced a gradual extension of irrigation may be expected, and it has, in fact, already begun. In some parts of the district, which I inspected while the settlement was in progress, a fairly large number of new wells were under construction.

In Hardoi, though the number of masonry irrigation wells increased from 2,461 to 7,609 during the currency of the expired settlement, irrigation is both insufficient and insecure. In the settlement year less than 20 per cent. of the cultivated area was irrigated, and the irrigation is mainly derived from lakes and marshes, so that the supply fails in times of drought. As experience has shown, Hardoi is peculiarly liable to suffer in bad seasons. It is perhaps the most precarious district in Oudh. The conditions unfavourable to the extension of irrigation are—

(*a*) The character of the soil: one-fifth of the area is *bhur*.

(*b*) The fact that the district suffers almost as much in wet seasons as in drought. On the western side of the district there is an extensive alluvial tract which is subject to inundations, while the better and more stable portion of the district is liable to serious injury in wet years from the overflow of the lakes and marshes, which are unusually numerous.

(*c*) Comparative sparseness of population. At the census of 1891 the density was 479 persons to the square mile. In 1901 it was 478 per square mile.

(*d*) The circumstances of the proprietors. Over 72 per cent. of the total area is held by small proprietors, a higher proportion than obtains in any other district of Oudh, and the majority of these men are in poor circumstances, without capital to improve their land or assist their tenants.

Q. 4.—The increase in rental derived from improvements in irrigation is exempted from assessment for the period of the settlement next following the date on which the works were constructed, that is to say, the exemption is for at least 30 years

In practice the Settlement Officer obtains lists of the wells and other works of irrigation that have been constructed in each estate since the previous settlement; and after inspecting the villages he makes deductions from the assets on which his assessment is based in order to allow for improvements.

The rules themselves are, I think, sufficiently liberal, though full effect has not always been given to them. The chief difficulty in carrying them out is that it is not often possible to estimate the increase in rental arising from the construction of a well. There are no separate wet and dry rates in Oudh; as, in the irrigated tracts, practically all the land that requires water gets it in ordinary seasons, so that the effect of the construction of a well is rather to increase the stability of the rental than to raise its actual amount. The usual course has been to deduct a certain amount from the assets proportionate to the estimated cost of the well or other irrigation work. Ten per cent. on the cost has generally been considered a fair allowance.

Tenants in Oudh who have extended irrigation to their holdings at their own cost are not specially protected from enhancement. But, like other tenants, they are only liable during their lifetime to enhancements of one anna in the rupee at intervals of seven years. And if a tenant has made an improvement in the manner authorized by the Oudh Rent Act, he or his representative cannot be ejected until compensation has been paid. In order to secure compensation the tenant must either have obtained the written consent of the landlord to the making of the improvement, or the permission of the Deputy Commissioner if the landlord refuses or omits to grant written consent (sections 22—24, Act XXII of 1886).

In my opinion the existing provisions are sufficient, and I have no alteration to suggest.

Q. 5.—The amounts advanced under the Land Improvement Loans Act, XIX of 1883, during the five years 1895-96 to 1899-1900 are given below:—

	Rs.
Lucknow	1,59,078
Unao	83,849
Rae Bareli	2,02,243
Sitapur	1,09,320
Hardoi	1,67,597
Kheri	8,883
TOTAL, LUCKNOW DIVISION	7,30,920
Fyzabad	32,437
Gonda	21,162
Bahraich	2,415
Sultanpur	1,08,512
Partabgarh	53,830
Bara Banki	89,929
TOTAL FYZABAD DIVISION	3,08,285
GRAND TOTAL	10,39,205

By far the greater portion of this (Rs. 8,68,301) was advanced in 1896-97, the year of scarcity. It includes large advances for the construction of earthen wells. In ordinary years there is no great demand for these advances. The reasons, I think, are that Oudh is not deficient in natural sources of irrigation, while the more advanced districts are already pretty fully supplied with well irrigation; and, secondly, that there is in most districts a body of large and well-to-do proprietors who can afford to improve their estates without assistance from Government.

I do not think that loans would be encouraged to any great extent by any of the measures proposed. What I believe chiefly deters smaller proprietors from taking loans is the somewhat cumbrous procedure, and the fact that by taking the loan the borrower becomes the debtor of an irresistible creditor who can sell up his property summarily under the Land Revenue Act.

Q.6.—I can give no such instance, and I do not believe that the tendency referred to exists.

As regards the second part of the question, the only desire evinced by the people on the subject is that canals should not be brought into Oudh. This feeling is very general and strong, and I believe that it is shared by most officers who are acquainted with the province.

THE QUESTIONS UNDER B DO NOT APPLY TO OUDH WHERE THERE ARE NO CANALS.

C.—CANALS OF INTERMITTENT FLOW.

Q. 12.—As regards "C.—Canals of intermittent flow," in pargana Tulshipur, which lies in the north of the Gonda district under the outer range of hills, there is a system of irrigation by channels from the hill streams. The land on the banks of these streams is generally higher than the surrounding level: the beds are dammed up in suitable places, and channels cut through to the lower lands. Showers often fall on the hills when the plains are dry, and the water which comes down in the streams flows through the channels into the fields. These channels are known as *kula*.

Q. 13. (1) and (2).—This method of irrigation is only used for the land in which transplanted rice is grown.

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This is the main crop in this part of the country, and in lands where it is grown it is the only crop of the year.

(3) The supply of water is so casual and intermittent that no definite answer can be given. In a year of drought the supply would probably fail altogether; in a year of scanty rainfall it might save the rice crop.

Q. 14.—I can give no answer to this question which is scarcely applicable to the method of irrigation referred to.

Q. 15.—Wells are not used for the irrigation of the rice land in this tract.

Q. 16.—This question does not admit of a definite answer in the circumstances described.

Q. 17.—(1) and (2) So far as I know no charge is made for irrigation from these channels.

(3) The pargana belongs to the Balrampur estate, which is permanently settled, and therefore not liable to enhancement of revenue.

Q. 18.—The water flows into the fields by gravitation, and the only expenditure necessary is that incurred in keeping up the dams and keeping the channels open. This is done by the cultivators with the assistance of the estate. The tenant is repaid by the increase in the produce.

Q. 19.—Is not applicable to the case in question.

Q. 20.—The first part of this question has been answered already. As regards the second part, the irrigation is controlled by the management of the estate, and no legislation is required.

Q. 21.—As said above, all the channels were constructed by private persons. No trouble has arisen, or can arise, as the entire pargana belongs to a single proprietor.

Q. 22.—It will be clear that irrigation channels of the kind described can only be made in special localities. The only other tract I know of in which they are in use is in the north of the Basti district, which is also in the neighbourhood of the hills. Here the system has been greatly developed and improved by the enterprise of European landowners, and a permanent supply has been secured by the construction of large storage reservoirs, with a regular system of canals for distribution. There is little room for the construction of further canals, the tracts in which there is scope for the construction of such works being so limited.

D.—TANKS.

Q. 23. I understand from the tenor of the questions under this head that they principally relate to large irrigation tanks constructed or maintained by Government, such as are found in some parts of Bundelkhand. There are none such in Oudh, where the tank irrigation is from natural sheets of water, excavations by the village sites, and small tanks constructed by private persons. Most of the latter were originally made for watering cattle and bathing purposes. Many of them, by the time they come into use for irrigation, have become mere ponds.

The answers below refer therefore to the tanks above described, as far as the questions are applicable to them :—

(1) The tanks are generally supplied with water by surface drainage from the land round them in the rainy season.

(2) The water is raised by the water lift by manual labour and poured into channels, whence it flows into the fields.

(3) In a year of good rainfall the supply might be sufficient for ordinary crops in the lands irrigated from the tank. In a year of drought it might fail altogether. In this connection the following figures, taken from the Fyzabad Settlement Report, may be of interest. The area in the district irrigated from tanks (natural and artificial) in the settlement year was 178,550 acres. In the year of drought it was only 46,526 acres : a fact which shows, as the Settlement Officer remarks, that in a year of drought it is not safe to calculate on much more than one-fourth the average tank irrigated area as being so irrigable.

(4) I can gave no general answer to this question. The area of course depends upon the size of the tank and the depth of water in it.

Q. 24. I can give no reliable figures showing the extent to which the produce is increased by tank irrigation. As regards (3) it has been shown above that little reliance can be placed on tank irrigation in a dry year.

Q. 25. This question seems scarcely applicable to tank irrigation of the kind described.

Q. 26. There are some natural reservoirs which give a sufficient supply without assistance from wells. But in ordinary cases the first watering is given from the tanks, and later waterings from wells (where available) to crops that require them. I should say that it is generally essential for safety to have wells.

Q. 27. I can give no reliable estimate under (1). As regards (2) the irrigation would probably fail in a year of drought.

Q. 28. Water rates are seldom charged by the landlords, and cannot of course be levied by Government.

Rents in Oudh are generally paid in a lump on the entire holding, and separate wet and dry rates scarcely exist. The average increase in rental derived from irrigation cannot therefore be stated with any exactitude.

For the same reason the average rate of enhancement of revenue cannot be stated. Wet and dry rates for assessment were only framed in one district (Hardoi), and there they were scarcely used.

Q. 29. Expenditure is necessary for the labour employed in lifting the water, and of clearing out the channels, and for the cost of the water baskets. This is borne by the cultivator, who is repaid by the benefit to his crop.

Q. 30. I understand this question to refer to tanks controlled by the Government. There is no recognised system for the maintenance of private tanks.

Q. 31. The distribution of water is generally provided for in the wajib-ul-arz (village administration paper) and other village papers. Disputes sometimes arise which are settled by the Courts. In the nature of the case there is no need for Government interference or legislation.

Q. 32. I think that it would be far better to encourage the construction of wells, as tanks are liable to fail when they are most required. Assistance, if necessary, can best be given by advances under the Land Improvement Loans Act.

Q. 33. This question appears principally to refer to tanks maintained by Government. Very little is done to prevent the silting up of private tanks ; but they are occasionally dug out in a dry season.

E.—WELLS.

Q. 34. (1) I note below such information as is available from the settlement reports :—

Rae Bareli.—Water is found in the north of the district at from 6 to 30 feet ; but in the south the distance is sometimes as much as sixty feet.

Partabgarh.—The average depth to water varies in the different parganas from 16 to 24 feet.

Sultanpur.—In four parganas water is generally found at from 18 to 20 feet from the surface, in four more the depth ranges from 24 to 27 feet, and in the four others the depth is usually 30 feet or more.

These are fair samples of the southern districts, where the average depth may be put at from 20 to 30 feet. In the districts north of the Gogra the depth to water is much less, and in the alluvial tracts water is found close to the surface.

(2) Cheap percolation wells are common north of the Gogra and in other lowlying tracts. Elsewhere the supply is chiefly from springs. The water level sank in the year of drought, but I know of no cases in which the wells ran dry or became too saline for use.

(3) and (4) The percolation wells referred to above, which are made of bricks laid in mud, can be constructed in Gonda for Rs. 30. They last for 20 years or more. The more

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expensive wells cost from Rs. 100 to Rs. 500 according to their size and the depth to water. In Sultanpur 600 wells, which were constructed from advances given in the time of drought, cost on an average Rs. 183. In tracts like Rae Bareli, where the depth to water is greater, the average cost may be put at from Rs. 200 to Rs. 250.

These wells last indefinitely. Some of those in Partabgarh are in full working order after 60 or 70 years.

(5) When the water is near the surface it is raised by the *dhurkul*, a lever weighted with earth at one end, and with an earthen pot at the other. Less commonly by the *charkhi*, a wheel over which two pots are slung. Both the *dhurkul* and *charkhi* are worked by manual labour. When the wells are deeper the water is raised by leather buckets (*pur*) usually worked by bullocks, but in Sitapur and Hardoi manual labour is often employed instead.

(6) Mr. House, the Settlement Officer of Fyzabad, notes that the irrigating capacity of a masonry well in the district is generally, he considered, about 10 acres. This estimate is perhaps a little high. For an ordinary well I should put the irrigable area at 8 or 9 acres.

(7) I can only give statistics for two districts, Rae Bareli and Partabgarh, which are, however, those where well irrigation is most general. In the settlement year in each of these districts the average irrigated area per well was a little over 6 acres. This includes the irrigation from earthen wells, but, on the other hand, many of the masonry wells in these districts are large and work several runs. The average in most other districts is probably not so high. It may be put at 5 acres.

Q. 35. I can give no reliable estimate of the extent to which the value of the produce is increased by well irrigation; but in years of scanty rainfall the benefit is very great, and in years of drought the crop could not be grown without irrigation.

Q. 36. I can give no reliable estimate under (1). As regards (2) the irrigation would be the saving of the crop.

Q. 37. For the reasons explained in the answer to question 28 the increase in rent or enhancement in revenue due to irrigation cannot be stated with exactitude. The introduction of irrigation no doubt generally produces a rise in rent, but not immediately or invariably. The increase is on the irrigable area commanded by the well, not merely on the area irrigated during the year.

Q. 38. There are occasional failures; but I think that, on the whole, the people are very fairly successful in their well sinking. I believe that the Agricultural Department does offer assistance in the use of boring tools, and that it has been made use of in estates under the management of Court of Wards, and found successful.

Q. 39. I am not in favour of the construction of wells by Government in land which is private property. In the first place, as has been shown in the answer to question 3, the people have shown no backwardness in extending well irrigation, so that Government interference is not required; and, secondly, wells made by Government agency are likely to be more expensive and less suitable than those made by landowners or tenants for their own fields. The large landowners, as experience has shown, are perfectly able and willing to improve their property by constructing wells; while in the smaller properties practical difficulties would arise, if the Government attempted to make wells, on account of the complexity of the tenures. I regard the scheme as unnecessary and impracticable in Oudh.

40. Q. Temporary earthen wells are very commonly used; and there is no district in Oudh, and few portions of districts except the sandy belts, where they are not practicable. Tens of thousands of them were dug in the autumn of 1896 after the failure of the rains, and the spring crops were thus secured. As an example of what generally occurred, I quote the following from the settlement report for Bara Banki:—

"During the autumn of 1896 no less than 20,000 earthen wells were dug by tenants, either from their own resources or by aid of liberal loans from Government and the Court of Wards. As a consequence the normal wheat area was sown and irrigated and the district was saved, as a whole, from very severe distress; and a bumper crop, the best for 17 years, was the reward for the peasants' strenuous exertions."

To encourage construction in a year of scanty rainfall, all that has to be done is to follow the measures that were successful in 1896. These were advice and persuasion by the district authorities and liberal distribution of *takavi*.

Mr. E. A. Molony.

MR. E. A. MOLONY, Collector of Ghazipur.

(*Allahabad, 22nd November 1902.*)

(*Replies to printed questions.*)

Question 1.—My answers refer to the Aligarh district. I was Collector of Aligarh for three years from March 1897 to March 1900.

Question 2.—I have no records to refer to and cannot say.

Question 3.—There are no obstacles to the extension of irrigation from—

(1) sparsity of population;

(2) fewness of suitable cattle;

(3) insufficiency of manure;

(4) unsuitability of soil.

(5) The canal officers can say whether the Ganges Canal has sufficient water for the extension of irrigation. I fancy it has if water is economized.

(6) I do not think lack of private capital prevents the extension of irrigation for three reasons—

(*a*) there is no scope for private canals in the district;

(*b*) as to tanks, the digging of the tanks is too expensive to be financially remunerative;

(*c*) as to wells, I do not think that want of capital is the reason for their non-construction. Zamindars who do not go in for well-sinking manage to find money for their extravagances or for buying villages, so it is clear that want of capital is not the chief reason for failure to build wells, though it may deter a few.

As to the lack of funds for the more expensive cultivation of irrigated crops, I have never heard it even hinted at as the reason why wells are not built.

(7) The fear of enhanced revenue assessment is undoubtedly one of the causes which prevents wells being made. The people do not know the orders of Government about the non-liability to assessment of revenue of the increased rental gained by irrigation improvements. When I was Assistant Settlement Officer at Lucknow, no one ever pointed out new wells until I began to make inquiries, and the people learnt by experience that I would assess lightly on land irrigated by new wells. Then they began to come forward, which shows clearly that they had not expected such treatment. Even now I believe the intentions of Government are not widely known. The Committee might inquire how many applications have been made under Board's Circular I-B. I fancy they will be found ridiculously few.

The fear of enhanced rent does not deter tenants from making wells. A non-occupancy tenant has not the right to make masonry wells, and an occupancy tenant would be able to plead successfully the construction of a well in a suit for enhancement.

(8) Uncertainty of tenure and defects of tenancy law have in the past prevented well sinking by tenants. Even a fairly enlightened zamindar like the Raja of Mursan would not allow his occupancy tenants to make *pakka* wells, though his action was illegal. The new Tenancy Act will do much good in this respect. I had numerous applications by occupancy tenants for permission to sink wells, which shows that they did not know their rights. In my answer to question 25 I make some remarks on amendments in the law.

(9) *Other reasons.*—There are certain tracts in which well-sinking and tank construction is well nigh impossible owing to the natural conditions or in which the initial cost is too great for the expenditure to be financially remunerative.

Question 4.—Land irrigated from works constructed by private capital is exempt from enhancement of assessment during the currency of the settlement next following the one in which the improvement was made.

In practice the exemption is secured by the Settlement Officer making an estimate of the reduction on the assets which he is prepared to allow on account of the improvement. Every Settlement Officer has his own method. I think I allowed about Rs. 50 for each good well. It depended on the well and the amount was settled by guesswork and not by calculation. I was not on settlement work when the distribution of *jama* was made, but I suppose the reductions went to the parties entitled to them.

Tenants can claim exemption from enhancement on account of the increased value of the produce of the land gained by irrigation improvements made by them. The existing provision seems to me sufficiently liberal. Assistant Collectors in general are glad to get hold of such an easy means of disposing of cases that are particularly troublesome. The existing provisions are sufficiently liberal. I have seen it advocated that Government should permanently exempt from enhancement of revenue land irrigated by means of masonry wells. If and when the present system of exempting for one whole settlement, together with the unexpired portion of the settlement current when the work was constructed, has failed after a fair trial, I would recommend permanent exemption, but the present system so far has had only the beginning of a trial.

Question 5.—Loans under the Land Improvement Act are not freely taken. The reasons are threefold—

(*a*) Overwork.

(*b*) Responsibility.

(*c*) Rapacity of subordinate officials.

(*a*) *Overwork.*—Tahsildars and Collectors have too much work as it is to get through it in a really satisfactory manner. Government will not accept the plea of overwork even in trifles. A District Officer has, therefore, to bear in mind that if he shows much activity in this line, he will almost certainly have to furnish explanations in some other department. This applies with greater force to Tahsildars, who have the very greatest difficulty in collecting *takavi*.

(*b*) *Responsibility.*—If *takavi* becomes irrecoverable, a Tahsildar thinks that it will be put down to his slackness, and he naturally is in no hurry to put himself in such a position. The amount of *takavi* that actually becomes irrecoverable is so small (except in the case of famine *takavi*) as to lead one to suppose that *takavi* is only given to people who have exceptionally good security and who could raise money in the ordinary way.

If Government wish to extend *takavi* advances largely, I think that it must be prepared to accept a larger proportion of bad debts, and I think Collectors might be given authority to write off as irrecoverable a certain proportion, say 5 per cent., of the demand maturing in each year without having to furnish explanations.

(*c*) *Corruption.*—I have no doubt that the kanungo or other subordinate official who makes the local investigation and the tahsili accountants do in many cases take toll on the money advanced and recovered, but I do not think the amount is very large, nor can it be stopped till the standard of honesty of the *amla* is much raised.

(*a*) I would not recommend a reduction in the rate of interest, because the interest now charged is much lower than the market rate, and the necessity for paying it is not the reason for more *takavi* not having been taken.

(*b*) For the same reason I would not recommend a remission of the interest.

(*c*) In the matter of partial remission of the advances I think this might be tried in tracts where, owing to the cost of the works being very great, their construction would otherwise be unremunerative, but I would certainly not advocate it generally as it would tend to pauperize the people.

(*d*) Total remission in case of failure to obtain water would lead to great abuses, and is to be deprecated except in very exceptional cases. In most tracts the practicability or impracticability of wells is well known, and in all cases of doubt a trial boring should be made by the tube well which will definitely settle the matter.

(*e*) The period of repayment might perhaps be extended in the case of works which are very costly except where partial remissions are given.

(*f*) Grants-in-aid are precisely on the same footing as partial remissions.

My suggestions for the encouragement of loans under the Land Improvement Act are as follows :—

It is first necessary that for each tract in which objections are contemplated a survey of the relative position of the clay strata (*mota* or *tawa*) and of the water level be made as recommended by me in paragraph 20 of Agricultural Bulletin No. 12. This should be done by an official specially trained for the purpose. By this means a record will be obtained of the depth to which wells will have to be sunk in each village and the difficulties likely to be encountered.

Wherever there is a reasonable doubt about the depth at which the clay will be found trial borings should be made with the tube well apparatus of the Director of Land Records. It will then be a simple matter to estimate the cost of a well in any particular locality.

The official deputed for the purpose will then be in a position to say that in such and such a village wells are required in such and such positions which are likely to cost such and such sums. A permanent record should then be made of the wells considered desirable with their estimated cost. This completes the work of the special officer. A copy of the list should be furnished to the lambardar of each village with an intimation that Government will always be ready to sanction *takavi* for such wells up to the amount entered for each, provided that proper security is furnished.

The zamindars or tenants could, when they wished to build such a well, apply to the Collector for the advance.

No local inspection would be necessary, and it would only be necessary to verify the security.

At present the officer making a local inspection probably cannot in many cases ascertain what a well will really cost ; he may badly under or over-estimate the cost, and in either case there is a waste of money that might be more usefully employed.

Under the new Tenancy Act it is probable that the tenants will do most of the improvements, and it is very desirable that occupancy tenants should be allowed to give their holdings as security for their advances. For this purpose legislation will be required, and I would propose the following :—

Act to authorize certain tenants to use their holdings as security for takavi advances.

I.—When any tenant with a right of occupancy, but without a saleable interest, wishes to give his holding with the improvement proposed to be

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executed on it as security for a loan under the Land Improvement Act, he may apply to the Collector or Assistant Collector.

II.—The Collector or Assistant Collector shall issue a notice on the landholder.

III.—The landholder may object (1) on the ground that he is prepared to execute himself the same or an equally useful improvement for the benefit of his tenant; (2) that the proposed improvement is useless or unsuitable for the holding or inconsistent with the purpose for which the land was let.

IV.—If the objection is on the second ground, the Court shall decide whether the proposed improvement is proper, and, if it is, shall allow the tenant to give the holding as security.

V.—If the objection is on the first ground, the Court shall, if it thinks that the landholder's offer to make the improvement is genuine, give him a reasonable time in which to make the improvement; and if it thinks that the offer is not genuine, the Court shall pass an order authorizing the tenant to pledge his holding as security for the advance.

VI.—If the landholder fails to make the improvement within the time allowed, or any further time that the Court may allow, the Court shall pass an order authorizing the tenant to pledge his holding as security for the advance, and may give reasonable damages to the tenant from the landholder.

VII.—If the landholder raises no objection to the tenant's application, the Court shall pass an order authorizing the tenant to pledge his holding as security for the advance.

VIII.—When a tenant has taken an advance under the Land Improvement Act after having obtained an order under section IV, V, VI or VII, and has given his holding as security for the repayment of the loan, if he makes default in repayment of any instalment, or if he is ejected under the Rent Act, or if he dies without heirs or disappears, it shall be lawful for the Collector to sell his holding, and the purchaser shall have the same title and rights as the tenant whose holding has been sold.

Question 6.—The extension of irrigation does not tend to injure the remaining cultivation by drawing away its cultivators.

B.—CANALS OF CONTINUOUS FLOW.

Questions 7, 8, 9, *and* 10.—I do not feel qualified to answer these questions.

Question 11.- The result of draining land where there is a salt efflorescence is to remove the efflorescence. I noticed a very marked case of this. When I was in camp at Khair in 1886 or 1887, the land to the north-west of the camping ground was covered with at least two inches of *reh* as white as snow. Shortly afterwards the Karon Naddi drainage was carried out, and when I returned to the district in 1897 the *reh* had quite disappeared and the land seemed to me as if it had become cultivable.

C.—CANALS OF INTERMITTENT FLOW.

Questions 13 *to* 22.—There are no canals of intermittent flow in the district of Aligarh.

D.—TANKS.

Questions 23 *to* 33.—There are practically no artificial tanks in the district, but the natural *jhils* are much used for irrigation. They get filled up in the rains; no one ever looks after them or dredges them; no one charges water rate for the use of the water, but the zamindar of course gets higher rent for fields which can be irrigated. Some *jhils* never dry up even in dry years; in others the water is always used up except in years of excessive rain. Large *jhils* irrigate a large area and small ones a few fields only. When the water in a *jhil* lasts for the final watering well irrigation is unnecessary. The water is lifted out of the *jhils* by leather buckets of the shape of large dust pans with four cords worked by two men, one on each side. The only expense is the labour of lifting which falls on the cultivator.

The construction of artifical tanks is not required as the extension of irrigation can be better secured by the construction of wells.

E.—WELLS.

Question 34.—(1) It is most important to dismiss at once the idea that a well is simply a hole sunk in the ground till water is reached, and that in some places there is water and in some no water. There is water everywhere, but in some places it is not attainable in sufficient quantities for irrigation. The question to ask is not is there water, but is there a *mota* or *tawa*, or by whatever other name the all important combination of clay or *kankar* and sand is locally known. This stratum of clay or *kankar* overlying water bearing sand is necessary to form a roof to the collecting cavity in the sand which is essential if a large discharge of water is required, as otherwise sand is drawn into the well and the foundation is undermined. The subject is treated of in Agricultural Bulletin No. 12 and it cannot be profitably condensed further. Every spring well must be taken down to the *mota*, and consequently the depth of the water level from the surface is not necessarily any criterion of the depth of the well. As has been shown in the bulletin, a rise or fall of five feet may make a difference of 20 or 30 feet in the depth of the well; therefore it is very difficult to say what is the average depth of permanent wells. The depth of the percolation level from the surface varies from about 10 feet near the main Ganges Canal to about 55 feet in parts of pargana Mursan, and the wells must of course be still deeper. There are a few *pakka* wells in pargana Mursan, the cylinders of which are 75 feet long.

(2) It is of great importance to bear in mind that percolation wells are practically non-existent in the district. A percolation well would with difficulty irrigate an acre of crop each season.

Pakka wells are not liable to fail in years of drought, as no one makes a *pakka* well unless he knows that the *mota* is sufficiently submerged to give sufficient allowance for a fall in the water level in a year of drought. If this is not the case, it is quite effective and much more economical and easy to make a *kachcha* well. In the south-west part of the district many *pakka* wells have become permanently useless owing to a gradual change in the water level. I reported the matter, and the Mat Branch of the Ganges Canal is, I believe, to be carried out to set matters right.

Saline wells.—There are certain wells in the district which are always salt, but which get salter in a year of drought. The amount of salinity varies from a hardly noticeable brackishness to such a degree of salinity that neither man nor beast can touch it. Whenever the salinity of the water is considerable it is useless for germination purposes; seed sown on ground irrigated with it will not germinate; but after the seed has once germinated the salt water is very good for the crop.

(3) The average cost of construction of *pakka* wells varies from Rs. 50 to about Rs. 1,000 or Rs. 1,200 according to locality. The average cost of *kachcha* wells varies from about Rs. 4 to Rs. 50. The difference in the case of *kachcha* wells is chiefly due to the cost of the wooden lining (*garoli*) that has to be sunk when wet sand overlies the *mota*; the actual cost of digging is nearly always inconsiderable.

(4) The average duration of *kachcha* wells varies very much; sometimes a well falls in before it is even finished or only lasts a few weeks. In other cases a well lasts a lifetime. I have seen *kachcha* wells working, said to have been 40 or 50 years old. Where the earth is firm *kachcha* wells will last for a long time.

(5) Water is raised by a leathern bucket worked by two pairs of bullocks on the *kili* system.

(6) and (7) I can't say without statistics.

Questions 35, 36, *and* 37.—I cannot answer these questions.

Question 38.—(1) As explained in the reply to paragraph 34, there is water everywhere sufficient for domestic purposes, but its availability for the purposes of irrigation

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depends on the presence of a *mota*. I have given some proposals in the answer to question 5. The chief thing that the people require is that Government should have a survey of the *mota* made, and that in cases of doubt its existence should be verified by means of trial borings.

(2) Difficulties are encountered in the actual construction of wells, but native professional well-sinkers understand practical well-sinking far better than most British engineers, and need no help except in the provision of efficient sand dredgers. I would suggest that a Bull's patent dredger should be put in each tahsil for hire at the rate of Re. 1 per mensem. These dredgers are much more efficient than the native *jham*.

The tube well apparatus of the Director of Land Records can be lent to any one who applies for it. I have utilized it with great advantage in Court of Wards' villages, and Ahmad Said Khan of Nah in the Atrauli tahsil also applied for the services of the tube well-sinkers, but I don't know whether he ever actually utilized them.

Question 39.—I am not in favour of the construction by Government of wells in private property. This has been tried once before—*vide* the papers relating to the construction of "wells" published a good many years ago by the Department of Land Records and Agriculture, and ended in failure.

In the first place, most engineers do not understand the conditions necessary for success. The wells sunk by the Public Works Department are generally for drinking purposes only and present no difficulties. Irrigation wells are on quite a different footing.

In the second place, the Public Works Department rates are extremely high; and, if the salary of the supervising staff is charged to the work, I am almost certain that the work will cost two or three times as much as the zamindars would pay for the same kind of work.

In the third place, if Government pays the cost and charges a water rate, endless dissatisfaction will be caused, because—

(1) the rate will be much heavier than would have been necessary had the zamindar done the work;

(2) the collection of the rate would mean constant meddling by the subordinate staff and the necessity for bribing;

(3) it would in some cases be very difficult to say whether a field was irrigated from a zamindar's or a Government well;

(4) the cost of repairs of thousands of wells scattered all over the country would be very great and the supervision necessarily most perfunctory.

Question 40.—A very large part of the well irrigation is from *kachcha* wells. Some *kachcha* wells are anything but temporary, but others of course last only a very short time.

The next question—"how far are they a protection against drought"—is very ambiguous. If it means "in years of drought, can a tract ordinarily without irrigation be irrigated by means of *kachcha* wells," the answer is only in a very few and rare cases. If it means "in a tract ordinarily irrigated by *kachcha* wells, does the water fail in a year of drought," the answer is only in a few rare cases. The fact is that the failure of one monsoon makes very little difference in the sub-soil water level. Out of an average of 30 inches of rain, supposing that 2 inches are evaporated, that 13 inches flows off, and that 1 inch is formed into hydro-carbons, then only 14 inches soak into the subsoil. If you put 14 inches of water into a long glass cylinder and then pour in sand till the top of the sand and water coincide, you will get the depth of dry sand that will absorb 14 inches of water. It will probably not exceed 3 feet. It follows that a total failure of the rains in one year will only lower the subsoil water level about 3 feet (making no allowance for the supplies required for wells).

This amount of fall in the water level will only affect a very small proportion of the *kachcha* wells, *i.e.*, wells in those localities where the conditions are such that (*a*) wells can only just be made, or (*b*) wells can just not be made. For instance, take a tract in which the *mota* is only submerged 9 feet, a reduction of 3 feet would very seriously affect the discharge of *kachcha* wells in such a tract. Again, take a locality in which the *mota* is covered by 16 feet of saturated sand; in such a locality *kachcha* wells would be practically impossible; but if the depth of saturated sand was reduced to 13 feet, it is probable that wells might be successfully sunk.

It may, in fact, be enunciated that any change in the water level, whether a rise or a fall, will make *kachcha* wells possible in certain localities where they were not possible before and will make them impossible in certain localities where they were before possible.

With reference to the question how I would propose to encourage their construction in a year of scanty rainfall, the answer is that in such seasons the cultivators know that it is as necessary to dig wells as to plough and sow the land; they also know how to do it.

The only question for decision is— have they the means both to dig and to plough and to sow. If not, they should get *takavi*. If what I have before suggested is carried out, most of the data will be known. The cost of a well in each village will be known; the cost of seed per *bigha* and the area of each tenant's holding will also be known; and the only thing that will not be known is how much of the total estimated expenditure each tenant can provide and how much should be lent him. This will have to be guessed by the distributing officer.

Question 41.—I have now answered all the questions put down, but I would crave permission to make a few remarks on the proper relations between well and canal irrigation.

Canal water is precious and requires to be economized, as there are many tracts that require it very badly, and for which water is not at present available.

In my answer to question 40 I have stated that any change in the water level will make *kachcha* wells possible in certain localities where they were not possible before, and will make them impossible in certain localities where they were before possible.

Government and its officers have heard a great deal about the introduction of canals having caused *kachcha* wells over large tracts to collapse, but they have not heard anything about the areas where the introduction of canal irrigation has made possible the construction of *kachcha* wells, for the very good reason that the people won't use well irrigation or even admit that *kachcha* wells are possible when canal irrigation is so cheap.

My suggestion is that a complete survey of the *mota* should be made all over the Ganges-Jumna Doab and the tracts classified somehow as follows:—

(*a*) Canal irrigated villages in which *kachcha* wells are impossible, and in which they would remain impossible with any possible reductions of the subsoil water level.

(*b*) * Canal irrigated villages in which *kachcha* wells are impossible, but in which they would be rendered possible by a practicable reduction of the subsoil water level.

* See note to (*c*).

(*c*) Canal irrigated villages in which *kachcha* wells are possible, and in which they would remain possible after the reduction of the subsoil water level caused by a withdrawal of canal irrigation.†

(*d*) Canal irrigated villages in which *kachcha* wells are possible, but in which they would not remain possible after the reduction of the subsoil level caused by withdrawal of canal irrigation.

(*e*) Other villages in which *kachcha* wells are impossible, and in which they would remain impossible with any practicable raising of the sub soil water level.

(*f*) Other villages in which *kachcha* wells are impossible, but in which they would be made possible by a practicable raising of the subsoil water level.

(*g*) Other villages in which *kachcha* wells are possible, and in which they would remain possible after the rise in the subsoil water level caused by canal irrigation.

(*h*) Other villages in which *kachcha* wells are possible, but in which they would not remain possible after the rise in the subsoil water level caused by canal irrigation.

It is clear that canal irrigation must be maintained in villages in classes (*a*) and (*d*), but that it might be wise to withdraw it from villages in classes (*b*) and (*c*).

It is also clear that canal irrigation is indicated in villages in class (*e*) and perhaps partial canal irrigation in villages in class (*f*), and that canal irrigation is not required in villages in classes (*g*) and (*h*).

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† NOTE—Classes (*b*) and (*d*) would probably be very small.

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A careful consideration of the whole case would show the probable result of withdrawing canal irrigation from classes (*b*) and (*c*) and giving it to classes (*e*) and (*f*). It might be that the changes likely to be caused in the subsoil water level would be found to affect villages in class (*h*) so severely as to necessitate the extension of canal irrigation to them also or the abandonment of the scheme, but it is probable that the result of such a working plan would be to economise canal water where it is not essential and make it available for villages that want it very badly.

In any case Government would be able to make a forecast of the probable effect of new distributaries and drainage cuts, and to see where spare water should be used to fill tanks and where it should not; where more water is required and where less.

Of course the owners should have to be compensated for the withdrawal of canal irrigation, and this should be done on a liberal scale. The necessity of granting compensation would be a guarantee that the withdrawal was only made for good and sufficient reasons.

Question 42.—I believe that it would be possible in certain localities to raise the subsoil water level to a perceptible extent without any very great expenditure.

Examples are given in Colonel Clibborn's report on irrigation printed in the "Papers relating to the construction of wells" referred to in my answer to question 39, showing the extraordinary effect on the subsoil water level of a local source of supply.

What I would propose for a tract like pargana Mursan, most of which has suffered from a very heavy fall in the subsoil water level, would be to make the Karon Nadi, the local course of supply, more efficient. This would be effected in two ways: the first by building a series of low dams to hold up the water at the end of the rains; and, secondly, by sinking some *kachcha* wells in the bed of the stream till they reached the water bearing sand stratum. These wells would then be filled with coarse sand or fine gravel. At the top they would be widened out, so that even if a deposit of silt formed over the sand, the area would be sufficient to give a good supply of water to the well.

It is a well known fact (*vide* Encyclopædia) that an artesian well can be made to absorb the same amount of water as it gives out if the discharge pipe is carried up to double the height above ground level to which the water will naturally rise; and if a head of 8 feet in a well will give a very large discharge (as it undoubtedly does), there is no reason to doubt that a head of 40 feet or more as there would be in such a well would give a very large supply to the subsoil. This supply would be continuous as long as there was any water in the river, and a series of such wells would undoubtedly to some extent counteract the fall in the subsoil water level.

Wherever there is a canal flowing through a tract in which it is advisable to raise the subsoil water level the surplus water should be utilized to fill tanks instead of being sent down escapes.

1. *Q.* (*The President.*)—You are now Collector of Ghazipur?—Yes.

2. *Q.* Until March 1900 you were Collector of Aligarh for three years?—Yes.

3. *Q.* Have you been at Ghazipur since then?—I have been there for two years.

4. *Q.* Then you have experience of both districts?—Yes.

5. *Q.* You say in reply to question 7 "the fear of enhanced revenue assessment is undoubtedly one of the causes which prevents wells being made. The people do not know the orders of Government about the non-liability to assessment of revenue, of the increased rental gained by irrigation improvements." Have not the orders been published all through the country by means of the *patwaris*?—I don't know to what extent the Board's circulars have permeated down to the agricultural classes.

6. *Q.* Are these orders recent?—As far as I know they are probably seven years old. My reason for saying this is that I was Assistant Settlement Officer at Lucknow for about two years and I wanted to bring down the enhancement of revenue as far as possible; in fact, these were our instructions, and I thought that one of the best methods of doing so would be to allow a reduction for new masonry wells, and at first I found great difficulty in ascertaining what the new masonry wells were, because people did not seem to like to say which were the new wells. I believe they thought I was searching for them to enhance on them, whereas after a time when they began to understand they were getting a reduction, then they came forward a bit more.

7. *Q.* But that was how long ago?—About six or seven years ago, I should think.

8. *Q.* Mr. Roberts says the orders were out long before that?—They may have been.

(*The President.*)—It surprises me that they should not get to know a thing which so fundamentally concerns their own interests.

9. *Q.* (*Sir Thomas Higham.*)—Your staff would know where the new wells were?—I could find out where they were.

10. *Q.* They could not conceal that?—No.

11. *Q.* (*The President.*)—You go on to say—"The fear of enhanced rent does not deter tenants from making wells. A non-occupancy tenant has not the right to make wells, and an occupancy tenant would be able to plead successfully the construction of a well in a suit for enhancement." As a matter of fact, do the occupancy tenants make wells?—I think a very considerable number of wells are made by tenants.

12. *Q.* Ghazipur is a permanently settled district; is not it?—Yes.

13. *Q.* What is the arrangement there as regards enhancement for wells?—There are a certain number of fixed rate tenants whose rent cannot be altered or enhanced under any circumstances; the status of the other tenants is the same as in other parts of the United Provinces.

14. *Q.* Therefore after a certain number of years there would be enhancement?—It would depend whether the landlord applied to enhance or not.

15. *Q.* As regards the landlord, what does he pay suppose he made any improvements?—He would not have to pay any extra revenue to Government.

16. *Q.* Nothing?—Nothing.

17. *Q.* You say—"I would not recommend permanent exemption, but the present system so far has had only the beginning of a trial." Was it not in the settlement of 30 years ago?—I have no personal experience to judge, but from the assessment statements I have seen in Lucknow, which I was re-assessing, I never came across a case in which they seemed to have made allowance for improvements of that sort.

(*Mr. Roberts.*)—The settlement now expiring was made 30 years ago. There was then no way of bringing the benefit of improvements—wells, which were mostly tenants' wells—down to the tenant, because the landlord took the rent and the assessment was based on the landlord's rent, modified in the old settlement by the Settlement Officer's estimate of what the rent ought to be.

(*The President.*)—There was never any idea of diminishing the estimates on condition the landlord made a corresponding diminution in his rent?

(*Mr. Roberts.*)—No.

18. *Q.* (*The President.*)—You say in reply to question 5—"Loans under the Land Improvement Act are not freely taken," and you give three reasons for this, *viz.*, (*a*) over-work, (*b*) responsibility, and (*c*) rapacity of subordinate officials. We have had very much the same evidence all over the country. You go on to say—"Tahsildars and Collectors have too much work as it is, to get through it in a really satisfactory manner." Are you, to begin with, in favour of pushing on *takavi* advances and giving them freely for land improvements, say, for wells?—It seems to me that in an ordinary season you don't get much in the way of applications for *takavi*, but it is when the crops are very bad and the people have a difficulty in paying their revenue that you get a great rush of applications for *takavi*, which always gives rise to the idea that the desire to get *takavi* is not so much the desire to improve as to get a little ready cash. And then again when you give out *takavi* you really do not know what a well will cost, and you have to rely on the *kanungo* or Tahsildar's report that a well is really

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needed; and all these things take up so much time and there is such delay and leakage that I don't know at present that you really would do very much good by giving *takavi.*

19. *Q.* Would you advocate a special officer being told off to go about with money in his pocket, and to take up these cases and settle them in a more summary way? Do you think that would be an improvement?—I think, if you have one officer to give *takavi* and the other to collect it, you will find that a very fair amount of *takavi* will be realised with great difficulty, because the Tahsildar reports for *takavi* given through the Tahsildar, and he is the best man to know with what difficulty Government dues are likely to be collected.

20. *Q.* As a matter of fact, do the Government lose very much in bad debts from *takavi?*—I think they lose very little, except possibly with famine *takavi,* of which I have had no experience.

21. *Q.* Do you think, if certain difficulties could be got over, that it would be for the good of the country to borrow more from the Government for improvements like wells?—Yes, I certainly think it would be a good thing; only you want a more or less settled plan of operations, and you also want to know where wells are required and how much they are likely to cost, so that when a man applies for *takavi* you could look up his village and say "a well here will cost so much, and there is a real necessity for wells here." Then you would save one preliminary inquiry any way. You would say to the applicant "a well in your village is likely to cost Rs. 250; and if you can furnish the necessary security, I will lend you Rs. 250." And then you would save time too.

22. *Q.* (*Sir Thomas Higham.*)—Is there any limit for the amount given for a well?—For any particular well there is no limit. You are bound by the amount allotted to you.

23. *Q.* (*The President.*)—Do you generally spend as much as you get allotted to you?—It depends chiefly on the season. If it is a bad season, you could generally spend much more than is allotted to you, while in a good season you may find difficulty in spending what you have got.

24. *Q.* In how many years do you generally require the advances to be repaid for *pakka* wells?—In Ghazipore six or seven years generally.

25. *Q.* Do you remember what it was in Aligarh? About the same generally?—I cannot remember.

26. *Q.* Elsewhere in the south of India they grant 20 years, and the law allows you to go as far as 30 years. Do you think the people would take advances more readily if there was a longer time given to them in which to repay?—I should think they probably would, but your security in the meantime might have been deteriorating.

27. *Q.* Yes, Government has got to risk a little?—And again in some places wells cost a great deal of money, and of course the more you could spread it out, the more likely people are to borrow.

28. *Q.* Do you think then that a little more elasticity in that respect might be helpful?—Yes, I think it very likely would.

29. *Q.* You say, replying to question 5 (*d*)—"Total remission in case of failure to obtain water would lead to great abuses and is to be deprecated except in very exceptional cases." What are the great abuses you refer to?—It is exceedingly difficult to say whether you will get water or not. If they knew there was a chance of getting it remitted, they might borrow a large sum for building wells with the full intention of spending about a quarter of it on the pretence of building the well and pocketing the rest.

30. *Q.* Do you think they really would do that?—Yes.

31. *Q.* (*Mr. Muir-Mackenzie.*)—You could get over that by making the advance in instalments; could you not?—Yes, to a certain extent, but it is very difficult very often to say how much a man has spent; and, as far as I can see, it is impossible to estimate in some cases definitely what a well is likely to cost unless you know exactly the substrata and the depth you will have to sink.

32. *Q.* (*The President.*)—Would you advocate having boring apparatus at the head-quarters of each district to be lent out when required?—You would also have to have a trained staff to work this boring apparatus.

33. *Q.* There is a man now attached to the Agricultural Department for this purpose. Would it be a better thing to have several men attached to the department, say, one in each district?—I think, if you had one man in each district, probably he would be idle a good part of his time.

34. *Q.* On the other hand, if the thing was really being seriously taken up, one man for the whole of the United Provinces would not be enough?—No.

35. *Q.* (*Mr. Roberts.*)—Have you made use of him?—Yes. I had charge of some Court of Wards' villages in Muttra, and I had up the departmental tube sinker and I tested for the *mota* and I found out the exact depth, and the wells in that place had to go down to 82 feet. It was all sand down to 82 feet.

36. *Q.* (*Mr. Muir-Mackenzie.*)—And you built wells at that depth?—Yes, a well was built. It was completed just before I left Aligarh or just after; I forget which.

37. *Q.* (*The President.*)—It would cost a lot of money?—Yes. It would cost Rs. 800 at least.

38. *Q.* (*Mr. Muir-Mackenzie.*)—Will it be worth the money when you have got it?—Of course there is a limit when it becomes too expensive.

39. *Q.* (*The President.*)—I suppose the water would rise in it?—There are probably 40 feet of water in that well.

40. *Q.* You would not have to bale it up from 82 feet?—No; the water rises up. You often have to take a well so low, not on account of the water level being too low, but on account of getting no foundation.

41. *Q.* Then, as regards questions 23 to 33, I would like to ask you; do you think it would be a good thing for the country if the Canal Department at slack seasons were to fill up *jhils* and tanks?—Yes, but it depends on the locality. In some places the water level is high and the country is water-logged, and there it would be a bad thing; but there is a part of Aligarh district in the south where the water level has been sinking continually for years and where many masonry wells have become absolutely useless, and there it would be a good thing.

42. *Q.* (*Sir Thomas Higham*)—What was that supposed to be due to?—I think it is due to the drainage.

43. *Q.* (*The President.*)—To over-drainage?—Yes.

44. *Q.* In your answer you suggest that Bull's dredger would be a good thing to have in each Tahsil?—Yes.

45. *Q.* Is Bull's dredger used much in sinking wells?—The Hathras Municipality sometime ago sank a well in the Town Hall compound, and one of the *banias* in charge of it borrowed a Bull's dredger for the purpose from Aligarh. They excavate the sand much quicker; the native *jham* is a very *kachcha* arrangement.

(*Sir Thomas Higham.*)—It depends on the depth. I think that the *jham* is better for a certain depth.

46. *Q.* (*The President.*)—In reply to question 41 you discuss the taking away of canal irrigation from people who have already had it, and you say "of course the owners would have to be compensated for the withdrawal of canal irrigation, and this should be done on a liberal scale." Do you contemplate under certain circumstances that it would be expedient to take away irrigation from people who have once had it?—I think I have said somewhere that until you know the relative position of the *mota* you cannot say what effect the taking away of canal irrigation would have on the practicability of wells; and if you had a regular survey made, you might be able to say for certain that the water level in certain tracts might enable wells to be conveniently sunk and deeply. In that case it seems to me such a waste of canal water to use it where you could get a sufficient supply from wells.

47. *Q.* We have a problem now before us in certain parts of the Punjab where there was fully developed well irrigation which was superseded by canal irrigation which has been going on for 50 or 60 years?—I should think, even if you had to pay down a good sum in cash compensation, it would be a good thing for the country probably to take it away.

48. *Q.* (*Mr. Muir-Mackenzie.*)—Of course that would be a matter as to what compensation you could give. But you also have to see that the other country does not deteriorate seriously?—Yes. And you ought to have these things surveyed beforehand to see what effect any change will

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bring about. In Meerut the Settlement Officer, Mr. Burkitt, told me that a large number of *kachcha* wells had become impossible in tracts where they had been before possible, owing to the canal.

49. *Q.* Were not these tracts saved by the canal?—Yes. No doubt the people themselves find the canal irrigation is cheaper than the well irrigation. Canal water is almost worth its weight in gold, and it seems a pity not to send it where it really is absolutely necessary.

50. *Q.* (*The President.*)—Would you systematically restrict the irrigation of a district to 30 or 35 per cent., or some figure of that sort?—That is a very difficult question. I was looking at the statistics of Ghazipur for the last year's *rabi* when there was no *hathia*, no Christmas rain, and, in fact, no rain at all; and I found that at least nine-tenths of the area in the places where irrigation was possible, except on the alluvial soil, was irrigated; and I know if there had not been that irrigation, on the unirrigated land there would have been practically no crop.

51. *Q.* What is the irrigation done?—Almost entirely from wells.

52. *Q.* Of course that is very different from bringing in outside water?—Yes.

53. *Q.* In the Aligarh district there is a great deal of *usar* and *reh*?—Yes.

54. *Q.* Have you ever seen cases where land has been reclaimed by drainage and brought back to cultivation?—Yes. Aligarh was my first district in India; I went there in 1886. I remember the camping-ground at Khair then. Most of it was *usar* with salt efflorescence, but when I went back five years ago I could hardly believe it was the same place. All the salt efflorescence had gone and grass was beginning to grow on it. There was a great difference in it.

55. *Q.* (*Sir Thomas Higham.*)—Was it cultivated at all?—The cultivation was gradually spreading and one man applied to me for a lease of some of the land which before had been absolutely uncultivable.

56. *Q.* (*The President.*)—There used to be a great deal of trouble in the old days, 25 years ago, on the east Karon Nadi from water-logging and swamping. Has that been improved?—Is that in the Aligarh district?

57. *Q.* (*The President.*)—Both in Bulandshahr and Aligarh?—There was no complaint about water-logging in Aligarh when I was there.

58. *Q.* You have had a good deal of experience in Aligarh of the relations existing between revenue and canal officers?—Yes.

59. *Q.* Do you think the present system works well?—I think so. I don't think it could be bettered.

60. *Q.* I daresay you know that in the south of India the whole charge of the irrigation really rests with the revenue officers, and that the canal officer does the technical part of supplying the water in certain distributary channels and so on. The whole of the minor distribution and arrangements as to where the water is to go rests with the Collector and his staff. Do you think that an improvement?—The present system seems to work quite satisfactorily, and I don't know whether the other system would. Unless it is supposed there are any particular advantages to be gained, I would leave well alone.

61. *Q.* In Ghazipur the irrigation is by wells?—Almost entirely by wells. There is a certain amount of tank irrigation too.

62. *Q.* Does Ghazipur adjoin Nepal?—No.

63. *Q.* (*Mr. Roberts.*)—*A propos* of what you were saying about the system of revenue collections for the canal irrigation, I have noticed occasionally in cases which come up to the Board, a great discrepancy between the canal *jamabandi* and village *jamabandi*. Do disputes arise as to the rates due and is there any difficulty about that, or are these only exceptional cases?—I don't think there ought to be disputes, because when the canal *amins* go to measure the irrigated area, the *patwaris* are supposed to go with them, and the *patwari* signs the canal *amin's* measurement, so that if there is anything wrong, they are supposed to reconcile them on the spot.

64. *Q.* Would the cases be rare then; do you think?—They are exceptional; they are due to disturbing influences.

65. *Q.* (*Mr. Rajaratna Mudaliar.*)—Could not the measurement and assessment be left to the *patwari* who has to go over the fields in preparing his statistics?

(*Mr. Roberts.*)—But here the canal authorities are furnished with the *patwaris'* papers and they have to go on that.

66. *Q.* (*The President.*)—Do you find complaints made against Canal Deputy Magistrates as being one-sided in their judgments?—No. I think my experience is that Canal Deputy Magistrates are generally extremely lenient.

67. *Q.* (*Sir Thomas Higham.*)—With reference to your reply to question 4 that "land irrigated from works constructed by private capital is exempt from enhancement of assessment during the currency of the settlement next following the one in which the improvement was made." Do you mean to say exempt from all enhancement at all?—It is supposed to be exempt from enhancement for the increased rental due to the irrigation improvements.

68. *Q.* With regard to your remark that a total remission in case of failure to obtain water ought not to be recommended, do you think there is the same objection to a partial remission?—It is so difficult to say when a man has taken a loan whether he has actually spent the money for the object he has taken it for, or whether his object in taking the loan was to save a part of it and to get the whole loan remitted.

69. *Q.* Is it possible to make the advances by instalments?—Yes, that is what is generally done.

70. *Q.* That is to say, you give a man one-third of what he asks for?—What I generally do is to decide first how much is to be advanced, and then I give him probably one-half of that, and when it is reported that he has done work to that value, then I advance him the rest.

71. *Q.* Is not that security against their taking more than they want for the work?—It would be if you could be certain how much money had been actually spent, but you have to rely on the report of your subordinate, who is not a trained man.

72. *Q.* Do you find that when wells are made that assistance is given in the village?—Yes, if a tenant makes a well, the other tenants will generally help him with labour and so on.

73. *Q.* That is one reason why wells should always be made by the people?—Yes; and not only that, but they do it very much cheaper than we can.

74. *Q.* You talk about dredging the *jhils*?—Yes. I mean digging out the earth that gets deposited in them.

75. *Q.* That would be a very costly business?—Yes.

76. *Q.* As regards the question of withdrawing canal irrigation from villages in which this is desirable, you suggest, that it would be well to pay compensation in such cases?—Yes.

77. *Q.* But would any compensation be acceptable to the people themselves? Would they be willing to give up their canal irrigation?—I think whenever anything is done compulsorily it is unpopular. If you take up land for a railway, there is always somebody who complains that he has not received his full compensation whether he has or not.

78. *Q.* Do they ever give up their canal irrigation in villages and take to wells?—I don't think it has ever been tried. I think there is an order of the Board saying that canal irrigation will not be withdrawn arbitrarily.

79. *Q.* Do you think canal irrigation could be restricted by increasing the rates in such tracts?—I think that is probably the most practicable method of doing it, because then the people who could use wells would do so, and the people who could not use wells would go on using canal water.

80. *Q.* They would have to make new wells?—It would depend on how long the canal had been working there. In some places there are old masonry wells which are still existing, but where *kachcha* wells were made before the canal was made, of course these have all long since fallen in.

81. *Q.* Would they make *kachcha* wells again or *pakka* ones?—That would probably depend on whether the water level had been seriously raised by the canal or not,

82. *Q.* Then of course directly you withdraw the canal irrigation, the water level will fall again?—If you withdraw it over a sufficient area, it probably will. The canal would make an alteration in the water level over a much larger area than where it is actually irrigating, because the whole subsoil after a certain distance is almost pure sand, and as soon as the water reaches that sandy strata, it raises the water level for a very considerable distance.

83. *Q.* When you withdraw your canal irrigation you would have another change, and you might have to re-introduce it again?—Probably there would be a certain amount of risk unless you had full data to go on beforehand.

84. *Q.* (*Mr. Muir-Mackenzie.*)—Can you give me any idea whether the number of wells entered in the statistical records may be taken as fairly accurate?—Yes.

85. *Q.* The *patwaris'* papers are practically correct as regards that?—Yes, very fairly so.

86. *Q.* That is to say, as to the number of wells used. If a well is not used, it will not be shown in the statistical records, so that it is not very easy to find out apparently what wells are new and what are old?—You could see that up to a certain year only a certain number of wells, say 25, had been actually used; and if, at the present day, you saw there were 45, the chances are there would be 20 new wells. And then you could look up the old settlement records to see which particular fields those wells were in, and you could always locate them.

87. *Q.* You had no difficulty in ascertaining from the *patwaris'* papers that there were a certain number of new wells. Your difficulty was to find out where they were?—On settlement work I had to inspect seven square miles of country every day. If you had sufficient time, of course you could find them out without any difficulty, but it would save you so much time if the people themselves came up and said there were such and such new wells.

88. *Q.* You say the fear of enhanced rent does prevent the tenants from making wells; are there no other difficulties? For instance, does the landlord not require his permission to be obtained?—I think in a considerable number of cases in Aligarh and Bulandshahr where the landlords had a great dispute with their tenants, they do not like their tenants to be at all independent, and I am quite certain that they often do their very best to prevent tenants making masonry wells.

89. *Q.* What would they do to prevent them?—The landlord has a great hold over his tenants. If they are not occupancy tenants, he can eject them; and even if they are occupancy tenants, a rich man can harass them in a thousand different ways.

90. *Q.* Quite sufficient to deter them from making wells?—Yes.

91. *Q.* Therefore may it be taken that in a great many instances, unless the tenant can square his landlord, he will have great difficulty in making wells?—Certainly, I think so; I have seen a tenant come up to the son of the Raja of Mursan and ask him to allow him to make his well *pakka*, and the Raja has evidently refused to allow it.

92 *Q.* (*Mr. Roberts.*)—And he is a fairly intelligent landlord?—Yes; I did not like to interfere between the landlord and the tenant, because I felt a tenant was so completely in the hands of the landlord that I should be encouraging him to his own loss. That was under the old Rent Act. This new Rent Act has put things on a much more satisfactory basis.

93. *Q.* (*Mr. Muir-Mackenzie.*)—That is to say, it will enable the tenant to re-settle the rental. But won't the landlord always be able to harass him?—Any way the tenant now knows he has a legal right to do it, whereas under the old Act it was not definitely laid down. You could only prove it by implication from various other sections.

94. *Q.* Now he knows he has a right to make an improvement?—Yes.

95. *Q.* Now in the districts with which you are acquainted, do you consider that it is possible to multiply the number of wells largely with advantage?—In Ghazipur I was lately looking up the statistics, and I find that in the last *rabi* season very nearly the whole area that could have been irrigated was irrigated from wells, so I don't think there is any great necessity for extending irrigation there.

96. *Q.* How did you judge what area was capable of irrigation from wells there?—There are certain tracts of country, the alluvial valley of the Ganges, where the substrata is almost sand for an unknown depth, and there wells cannot be made and are not used; and, as a matter of fact, these tracts do not require irrigation, because the soil is very retentive of moisture; but I found in pergunnahs away from the river that nearly the whole of the *rabi* area had been actually irrigated from wells.

97. *Q.* Therefore they don't want any more?—Yes, of course the more wells you have, the more careful your cultivation can be. You can grow more garden crops where you have numerous wells than where there are few.

98. *Q.* Is not there a certain amount of tank irrigation?—You can more or less divide the district up into three tracts and three classes of soil. The first is the alluvial tract, in which irrigation is, I should think, unnecessary and generally impossible; (2) the ordinary tract of loam without any *usar*, the greater part of which is irrigable by wells; (3) the *usar* tract in which rice is the principal crop; you cannot irrigate rice from wells, because it wants too much water; and you cannot grow *rabi* there. The only thing for that is to make embankments to hold back the water in nullahs and depressions.

99. *Q.* Is there much scope for increasing the number of embankments?—The great difficulty in the way of that is that the land is very much sub-divided among many villages. In each village there are a very large number of co-sharers, and you can never get these men to combine; two or three people may hold out and then the other people will say "we are not going to improve so and so's land at our own cost," and thus nobody does it.

100. *Q.* Do you see any remedy for that?—The law gives legal powers to compel partition if people desire it against the will of the others, and they have to pay up. It seems to me the only way of getting irrigation improvements through is to give legal powers to let a man apply for authority to make an improvement and charge the proportionate cost to the others. Of course that would be a very difficult thing to do.

101. *Q.* (*Mr. Roberts.*)—Apart from the quarrels of the shareholders, is not there another difficulty in improvements of that kind; for instance, if you make a *bund* in one field and other fields suffer from that *bund*, the people say "why should we lose six pence in order that the others may gain a shilling?"—Yes, it is a very difficult question. I had a case in my own experience the other day. There was a village in which the Court of Wards had a share and a large quantity of land had gone out of cultivation simply owing to a large embankment that had been made having been rendered useless by the escape being washed away, and I did not see why I should improve the whole village at the expense of the Court of Wards. So I had up the other co-sharers and I said to them "this is a very necessary work," and they all agreed that it would be a very good thing if it was done. I said to them "if all the co-sharers will join the Court of Wards in raising a loan, I am quite ready to give you the necessary *takavi* to do this work; only I am not going to do it at the whole expense of the Court of Wards If you want it done, you must all join in and give security jointly." Although I had made arrangements with a certain tenant who, they suggested, was the right man to do the work—I quite agreed to that; in fact, I agreed to everything they said.—not one of them would come forward and apply for *takavi*.

102. *Q.* And the work was left undone then?—Yes, the village is in a very bad way, so much so that we have got a lot of land on produce rents there, and the tenants will not sow it, nor will they relinquish it, and the ground is bringing us in absolutely nothing.

103. *Q.* (*Mr. Muir-Mackenzie.*)—That was owing to this work having fallen into gross repair. Was it nobody's duty to keep that work in repair?—It belonged to the co-sharers, and it was their business to look after it.

104. *Q.* It was their duty?—It was not a legal duty, but it was to their interests to keep it in repair.

105. *Q.* Is there no custom to the effect that the zamindars should keep these works in repairs?—I think generally not. In one or two arbitration cases that have come to my notice it has been decided that the zamindar has to construct a certain work and in time of need all the tenants must turn out and keep it in order.

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106. *Q*. How was that decision arrived at: on the custom of the country?—No. It was a case in which a zamindar had applied for enhancement of rent from a large number of tenants in his village and they had all agreed to refer the dispute to arbitration, and the arbitrator came to this decision.

107. *Q*. You don't think there is any definite custom in regard to such matters?—No. I don't think there is.

108. *Q*. Can you make any suggestion for keeping those works in a more efficient condition?—Without some form of compulsion, and unless you can invest some one with legal authority to do a work and charge part of the cost to the other people, I don't think anything can be done. It seems to me also that the ordinary natives of the district don't seem to understand how to make overflow weirs. I believe, if they were shown one or two overflow weirs, it is quite possible some of them might come forward and follow the example.

109. *Q*. Have you any river channels in Ghazipur?—No.

110. *Q*. In order to fill up the tanks you have not what they call *pains* in Bengal?—I don't think so. There are no embankments thrown across river channels if that is what is meant.

111. *Q*. You don't lead off the water by small channels from the streams?—No. The lift is too great to make it worthwhile. Of course they lift water out of tanks.

112. *Q*. (*Mr. Roberts.*)—In Ghazipur you have only one or two streams that could possibly be bunded?—Yes.

113. *Q*. (*Mr. Muir-Mackenzie.*)—To go back to the wells, when a tenant makes a well, of course the landlord gets no enhancement of rent?—He is supposed not to.

114. *Q*. Do you think he actually does?—I don't know. I have not come across cases of that sort. I should certainly knock off part of the enhancement if a case came before me, if a tenant had effected an improvement himself.

115. *Q*. Do you think he gets it by agreement?—It is very difficult to say.

116. *Q*. Had you made any land revenue settlements?—Yes.

117. *Q*. You did not allow for any enhancement of rent on account of wells, I presume?—The way I did it in Lucknow was to take the total assets as they appeared to be, and then to say there are so many new wells, for which I give a lump reduction on the assets.

118. *Q*. Whether the well was made by the tenant or the landlord?—The object was to keep the enhancement down as low as possible, so I did not make any particular inquiries as to whether a well was made by the tenant or landlord.

113. *Q*. If you had not been wishing to keep down the enhancement, you would have had to make some distinction?—I am not quite certain what the Board's circular says, or whether it distinguishes between the tenants' and the landlords' wells. If you are assessing on recorded assets the tenant has probably already got his reduction, because his rent has not been raised. If his rent has not been raised, he has already got the full benefit of it and therefore you don't allow anything on the revenue.

120. *Q*. Does the circular distinguish?—Yes, it does.

121. *Q*. Therefore when a tenant makes a well at the next settlement, Government will get no increase of revenue on account of that well?—None unless the recorded rent has risen in the meanwhile.

122. *Q*. And any rise in his rent ought not, if the law has been observed, to be due to the wells?—No, it ought not to.

123. *Q*. On the other hand, if a landlord makes a well, Government will get an increase of revenue at the next revision of settlement?—Yes.

124. *Q*. If the tenant makes a well, Government gets no enhancement if the rent has not been raised. If, on the other hand, the landlord makes a well, Government does get an enhancement?

(*Mr. Roberts.*)—Under the Act the rent of an occupancy tenant cannot be enhanced on the ground of any improvement effected by the tenant himself.

125. *Q*. (*Mr. Muir-Mackenzie.*)—Referring to the previous question of extending wells in Ghazipur, you do not think many more are wanted. What about the other districts? Can wells be largely extended, for instance, in Aligarh and Lucknow? Do you think many more wells could be made with advantage in those districts?—I knew nothing about wells when I was in Lucknow, so I can say nothing about the Lucknow district, and in the Aligarh district I think there probably is a considerable scope for increased well sinking, but there is this danger to be feared that if you increase the drain on the subsoil water-supply, it is quite possible it may fail.

126. *Q*. Have you ever formed any ideas as to how close you can make wells together in any part without trenching largely on the subsoil water-supply?—If you put one well down here and another well down, say ten yards off, I don't believe that it will affect the head of water to any considerable extent; at least not the permanent supply; but in a large tract of country, if you were to put down a large number of wells and work them altogether, then there is no doubt, I think, that the water level would fall.

127. *Q*. You have not come to any idea as to the limit as to whether you could work one well in 10 or 20 acres?—That would chiefly depend on the depth of the water level above what they call the *mota*. Working a well depresses temporarily the water level in the well. This depression of the water level is necessary to give the head necessary to drive the water through the subsoil into the well and may be styled depression head. If the normal depth of water in the wells of a tract was very considerable, say thirty feet, it is probable that any number of wells could be worked in that area without reducing the normal water level to a point at which the necessary depression head would not be available. If, however, the *mota* in a tract of country is submerged to a depth that leaves only a small margin beyond the necessary depression head, a large increase in the number of wells would probably be useless, because the fall in the normal water level of the tract would reduce the depth of water in the wells to something less than the depression head necessary to give the wells their proper supply.

128. *Q*. It is a very difficult thing to fix the limits; it depends on the particular circumstances of each tract?—Yes, but one or two wells close to each other, I don't believe do interfere. I have seen wells working very close to each other.

129. *Q*. What average do you say wells irrigate in Ghazipur; 11 acres?—I have just worked it out. It is, on an average, about 11 acres that a well will irrigate in a year.

130. *Q*. Did you work that out from the statistics?—Yes.

131. *Q*. Do you think they can be relied on?—Yes, fairly so.

132. *Q*. Have you such a constant check upon the *patwaris* that you can rely on them. I ask you this because in my own province, Bombay, this is very badly done?—The *patwari's khasra* is checked by several officials. Every well that is irrigating is supposed to be marked in a certain column and these are totalled up.

133. *Q*. Do you really think the check is well carried out?—I think it is fairly well carried out.

134. *Q*. (*Mr. Roberts.*)—When were the papers last revised in Ghazipur?—In 1882. In 1882-83 a regular settlement survey was made in Ghazipur, and everything was done under the supervision of the Settlement Officer. Since 1882 the Ghazipur papers are as correct as they can be.

135. *Q*. (*Mr. Muir-Mackenzie.*)—You suggested that, if necessary, a survey of the *mota* of all the wells should be made. Would that not be an operation that would take up an immense amount of time and expense?—It seems to me that it is really not a very difficult thing. I don't see why the *kanungos* should not be trained to do it.

136. *Q*. Trained to use the boring machines?—No. In a large proportion of cases the position of the *mota* is accurately known; there are only a certain proportion of doubtful cases which you would have to test.

137. *Q*. Your point is, the *kanungos* could do the survey and do it fairly well?—Yes. There would be a certain number of doubtful cases which would require to be tested.

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188. *Q.* How long do you think it would take to get a thorough survey of Aligarh?—The first thing absolutely necessary is to ascertain the technical terms in use in the different places. When I left Aligarh and went down to Ghazipur I found that the technical terms used in Aligarh were perfect Greek to the people in Ghazipur. I had to make inquiries and found out what the terms were that they used.

139. *Q.* How long do you think it would take?—A very considerable portion of the survey of the *mota* can be made by ascertaining and recording the knowledge possessed by the cultivators, and this should not be a long or costly operation. Even where the result of this inquiry proved that a *mota* was not known to exist the knowledge would be valuable. The first step would be to ascertain the vernacular technical terms in use in each district. The second is to train the *kanungos* as to the conditions of the subsoil required for wells to be successful. The third is to train the *patwaris* through the *kanungos*. The fourth is for the *patwaris* to ascertain, by local inquiry and plumbing existing wells, where and at what depths the *mota* exists. The results thus obtained would be tested by the *kanungos* and by a few peripatetic inspectors appointed for this purpose by the Land Records Department. From this preliminary investigation the country can be divided into tracts (*a*) where the *mota* is known to exist and where there can be very little doubt as to the practicability of wells or their cost, (*b*) where the *mota* is known not to exist at least down to particular depths which would fix the minimum cost of a well, the maximum being uncertain, the practicability of wells being very doubtful. In my opinion this much could be done for the whole province in about three years. When this had been completed, I would begin tube well experiments and take up by degrees the whole of tract (*b*) except in the following cases: (i) where the minimum cost is known to be too great for well sinking to be financially remunerative; (ii) where the water level is sufficiently high to enable percolation wells to be successfully worked; (iii) where irrigation is already sufficient or impossible owing to the nature of the soil or unnecessary. Until the area to be tested is ascertained, it is impossible to say what these experiments would cost or how long they would take.

140. *Q.* Putting aside famine years, you say Collectors do find some difficulty in getting rid of *takavi*?—Yes, in a great many places the people won't apply for it.

141. *Q.* Supposing you found some district undoubtedly capable of a large extension of well irrigation, that is to say, the soil suitable and the *mota* and other conditions favourable, do you think that if the Collector or District Officers pushed the matter they could get rid of large sums of money?—Yes, advances would be largely taken.

142. *Q.* Do you think then that one can go so far as to say that to a certain extent it is due to want of push that advances are as small as they are in ordinary years?—At present you are given *takavi* absolutely blindly.

143. *Q.* Do you think it is owing to that, or do you think that the number of officers who really care about the subject is not very large?—I would ask you to look at it from my point of view. I could distribute a large amount of *takavi* if I set myself about it, but I don't know how much Government money I am wasting or how much of it will be utilized. My staff is very bad and inefficient, and I feel at present that I would be doing as much harm as good in distributing a lot of *takavi*.

144. *Q.* Do you think that is what deters a lot of officers?—I think so.

145. *Q.* You cannot ascertain whether the money is properly spent?—Yes. I would like to mention one other matter, if I may. If there is any talk of the Karamnassa Canal, I believe there is a portion of Ghazipur in which it would do some good.

146. *Q.* (*The President.*)—Does Ghazipur cross the Ganges?—Yes.

147. *Q.* (*Mr. Rajaratna Mudaliar.*)—As regards the accuracy of these statistics, I find that in Saharanpur the number of wells in 1899-1900 was about 7,600; in 1900-01 the number was 6,800—a difference of 800; but the area irrigated has fallen from 72,787 acres to 16,627. Can you explain how it comes about that there is this large drop while the number of wells only decreased by 800?—No; I don't know how that can be explained.

148. *Q.* The same thing occurs in other districts, so that I am inclined to doubt whether these statistics are correct.

149. *Q.* What is the average area irrigated by earthen wells as compared with that served by masonry wells?—It depends; there are two kinds of earthen wells, spring wells and percolation wells; percolation will irrigate only a small area, and they are worked by counterpoised levers or "*dheuklis*."

150. *Q.* In a very dry year what would be the average area irrigated by each well?—In Ghazipur last year we had a very dry year, and 11 acres was the area irrigated by each well. There are not many wells in Ghazipur which run more than one *mot*; some of the wells are lever wells.

151. *Q.* How many waterings are given to each field?—Last year in Ghazipur they certainly had to irrigate before they sowed, and they must have irrigated twice afterwards.

152. *Q.* As regards repairs of irrigation works, you said there was no particular custom as to keeping them in order, but would it not happen that at the revision of settlement the Settlement Officer would have to reduce rents if works are in bad order?—Ghazipur has a permanent settlement.

153. *Q.* But where there is a revision of settlement?—Of course in a district which was temporarily settled the tenants might apply for a reduction of revenue on the ground that their irrigation works were not in proper order.

154. *Q.* And the Settlement Officer has power to grant an abatement of rent?—Yes, generally.

155. *Q* So that would afford the landlord a strong stimulus to keep the work in order?—Yes.

156. *Q.* As a matter of fact, are there any cases in which such reductions have been granted?—I have not come across any.

157. *Q.* As regards your objection to remission in cases of failure of wells, your chief difficulty is in making a correct estimate of the amount spent?—Yes, whether a man is honest or not.

158. *Q.* Could not a tahsildar be entrusted to make a proper valuation?—I think it is exceedingly difficult to estimate the amount spent on wells; in the first place, a considerable portion is under water and the bottom of the well may have been choked up with sand; you may be wrong as regards the depth of the well; then some masonry is first class and some second class. Tahsildars and even Collectors do not know the rates and find great difficulty in saying what is the cost.

159. *Q.* Could not the Public Works officers be asked to help in the matter?—They have a very fair amount of work to do already.

160. *Q.* But these cases would be rare?—Yes, perhaps.

161. *Q.* This point has been very strongly insisted upon in other provinces?—If you make a trial boring with a tube well, you can make certain at what depth water will be met and the cost, etc.

162. *Q.* But if you had, say a hundred applications, that would be very difficult?—It would be cheaper to spend more money in getting apparatus and making certain of the substrata than to spend, say, Rs. 500 on each well which may be absolutely wasted.

163. *Q.* In giving advances do you think it is absolutely necessary to find out the cost of the well?—I think so, because a man may know the cost will be Rs. 200 and think this will be a good chance of getting Rs. 400.

164. *Q.* You don't lose by giving the Rs. 400 so long as the security is good; what is the necessity for these inquisitorial inquiries; the idea is to encourage the construction of wells. As a matter of fact, do the people ever apply for larger sums than are necessary; are they not afraid of being indebted to the *sircar*?—I am afraid I have not sufficient touch with the people to be able to say.

165. *Q.* Do you experience any difficulty in recovering loans?—There is sometimes very considerable difficulty.

166. *Q.* Due to what?—I think it is due to proper consideration not having been given at the time the loans were advanced.

167. *Q.* (*Mr. Muir-Mackenzie.*)—Still if all is recovered?—This year I have sent up two or perhaps more proposals to sell up hypothecated land for famine advances. Comparatively small amounts have been written off as irrecoverable.

168 *Q.* (*Mr. Rajaratna Mudaliar.*)—Is the loan a first charge upon the land, or does the landlord's rent take

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precedence over it?—I think it is a first charge except on the actual produce of particular fields.

169. *Q.* Is the debt due to money-lenders recognized?—If the money-lender has a mortgage which is prior to the *takavi* loan, of course the money-lender's loan takes precedence.

170. *Q.* Precedence over the Government loan?—Yes.

171. *Q.* Do you not take encumbrance certificates before granting loans?— Yes, it is supposed to be done.

172. *Q.* If land is previously encumbered do you refuse loans?—Yes, unless it is only encumbered to a very small extent.

173. *Q.* On lands irrigated by wells are there differential rates of rent with reference to the crops raised?—Not in Ghazipur district; in some Court of Wards' estates an extra charge is laid on sugarcane.

174. *Q.* Not on other crops?—No.

175. *Q.* (*Mr. Roberts.*)—As regards *takavi*, advances are given for *pakka* wells?—Yes.

176. *Q.* Are advances made to tenants or landlords?—Generally to landlords, but sometimes to tenants who can give landed security.

177. *Q.* It is generally made to landlords?—Yes.

178. *Q.* As a matter of fact, have the existing wells been built by tenants or landlords?—I have come across a great number built by tenants; I think tenants sink quite as many as landlords.

179. *Q.* Dividing zamindars into cultivating and non-cultivating, which is it that build wells?—Cultivating.

180. *Q.* The larger landlords who live on rents don't build wells?—No; wells are built by tenants and cultivating landlords.

181. *Q.* And advances are mostly made to non-cultivating landlords?—Yes.

182. *Q.* What security can a tenant give for a well costing Rs. 300 to Rs. 400?—In Ghazipur they can give fixed rate holdings; other tenants have no security unless they have a share in some proprietary rights or unless they can get somebody to stand for them.

183. *Q.* Occupancy tenants' rights are not transferable?—No.

184. *Q.* A simple occupancy tenant on his holding has practically no security to offer for a large loan?—No.

185. *Q.* Is that not a great difficulty in the way of a proposal to increase *takavi* for building wells?—Yes, unless you make occupancy holdings saleable.

MR. S. H. BUTLER, C.I.E.*

(*Allahabad, 24th November 1902.*)

Mr. S. H. Butler.

1. *Q,* (*The President.*)—What posts have you held in this Province, Mr. Butler?—I have settled the Sitapur District and also the Kheri District. I was in charge of the Hardoi Settlement for some months. I have not done any real inspection work in Hardoi. Sitapur and Kheri are the two districts through which the old Sardah project went first.

2. *Q* You are, I suppose, pretty familiar with all the arguments *pro* and *con* of the Sardah Canal?—Yes, I am.

3. Q. What is your opinion?—I think it would ruin Sitapur. I understand they won't irrigate Kheri. Kheri and Sitapur are water-logged as it is. The spring level is said to be rising and to have risen very largely since 1871. This is an engineering question that I don't know anything about, but I do know that the whole of the Gumti *terai* has gone out of cultivation since the last settlement.

4. Q. When was that?—In 1896. 1871 was the year of the great Gumti floods; people say that the bed is silting up. It is absolutely essential according to the engineers, I believe that, if you run a canal through Sitapur, you should drain off the existing *jhils*, which are innumerable in the middle of the district, into the Gumti. Mr. King and Colonel Corbet doubted whether the Gumti would take so much water. I am certain it would not; the drainage is inadequate as it is at times of heavy rainfall. In 1871 the floods washed away parts of Azamgarh and did a lot of damage. In 1894 the floods came above the floor level of the Chutter Manzil. Whether these floods have silted up the bed, or whether the silting up has been a slow process, I don't know.

5. *Q.* It has not been made the subject of scientific investigation?—No.

6. (*Mr. Roberts.*)—There was a special enquiry in 1891. Mr. Passanah, an engineer, was put on to go about the country and see what could be done. I never saw the result?—People say the river has been bridged in so many places that the floods have been checked, and the bed thereby raised.

7. *Q* (*The President.*)—Is it possible that the Sardah water is getting into it?—The Gumti rises in swamps not far from the Sardah and possibly the Sardah water is getting into it. (Conversation over map.) The Sardah has completely changed its course. The small stream (the Dahawar) formerly connecting the Sardah and Gogra has now become the main stream.

8. *Q* When you say that introducing irrigation into Sitapur would ruin the country, do you mean that it would increase the water-logging that already exists?—Yes.

9. *Q.* Would there be any danger if a high level canal was taken through the district?—Yes.

10. *Q.* Even if water was passed through without giving irrigation?—I think it would be a very dangerous proceeding. You would have to take it right across the natural line of drainage.

11. *Q.* A proposal has been made of making a very much reduced Sardah Canal to cross the country there and of giving irrigation to Hardoi at the end of the *Kharif*?—It would not touch Sitapur. I could not give an opinion about Hardoi, except that the drainage is very complicated there already; it would be necessary to have a very careful survey.

12. *Q.* Are these distircts thoroughly well irrigated?—Yes. In the south of Oudh, as you know, wells are very numerous. In the four south-eastern districts of Partabgarh, Sultanpur, Fyzabad, and Rae Bareli 42,919 *pakka* wells have been made since the last settlement, 9,099 in Patabgarh, 7,461 in Sultanpur, 15,000 in Fyzabad, and 11,359 in Rae Bareli; in fact, there is a *pakka* well for every 30 acres of cultivation. In Unao, Lucknow, and Bara Banki, the three central districts, 18,717 masonry wells have been made since the last settlement.

13. *Q.* (*Mr. Roberts.*)—That is the settlement of 1869?—Yes, the first regular settlement since the annexation. There is about one well for every 60 acres of cultivation in these central districts. In the four districts of Hardoi, Sitapur, Kheri, and Bahraich 7,471 wells have been made since the last settlement, and there is one well for 225 acres of cultivation. I think these figures show that the complaints that landlords don't allow their tenants to make wells are unreasonable.

14. *Q.* (*Mr. Muir-Mackenzie*)—How many wells have been made by tenants?—I have separate figures only for Partabgarh; out of 9,099 wells 5,986 were made by tenants, and Partabgarh is a district in which there have always been, since the beginning of the Oudh controversies, the most numerous complaints that the landlords don't allow their tenants to make wells. These figures are taken from Mr. Sanders' Settlement Report. Of course landlords do sometimes object to wells being made, and I have myself investigated about 20 or 25 complaints by tenants; most of these were by high caste tenants who were in large arrears of rent; in one or two cases I thought the landlord was behaving arbitrarily; in one case I remember particularly he said the tenant was only making a well as a first step to getting a grove. You know, no doubt, that by a custom of the country wells and groves are married together. Sleeman talks of this custom in his books; it is

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**Note by witness*—This evidence refers only to the conditions of Oudh. This is stated in the evidence, but much of the evidence is stated very generally; and the limits on its application might be overlooked.

commonest among Rajputs, but it is also common among other castes. In Northern Oudh, where land is abundant, most people who make a well also get a bit of land for a grove from the landlord and the two are married with regular ceremony. In the south-east of Oudh the grove area is decreasing; the pressure of population is great, and the custom is, I imagine, breaking down, but anybody who can afford to have a grove and well will marry them. A man who digs a well cannot drink any water from it until it is married to a grove; and a man who plants a grove cannot take fruits from the grove until it is married to the well; that prohibition only applies to the person who makes the well or grove, not to other people. The figures show that in South Oudh the grove area is decreasing, while the well area is enormously increasing, which means that the custom is breaking down there.

15. *Q.* In the case of wells made for irrigation that is not necessary?—No; but everyone, who can, marries his well to a grove or a tree. These figures show that the tenants of Oudh are pretty well off.

16. *Q.* Were you in Oudh in 1896-97?—Yes, I was in charge of the Sitapur, Kheri, and Hardoi settlements.

17. *Q.* Was there much distress?—Distress was great in Hardoi, hut Hordoi had been broken by the wet years from 1890 to 1894; Sitapur had suffered, but it is a rich district; there are big landlords and they helped their tenantry through. Hardoi is a poor district with a great deal of sandy soil which suffers more than any soil in wet years; *bajra* and *moth* are destroyed entirely in very wet years. Hardoi has much sandy soil and it also has much which is waterlogged, so that it was broken before the famine and the famine came and finished it up. The settement which might otherwise have worked all right had to be revised. Hardoi will always feel drought; Sitapur will not, nor will Kheri.

18. *Q.* What are the chief crops?—*Bajra, moth, urd,* and *moong.*

19. *Q.* Would they not flourish in a dry year?—Yes, if they get water in good time, but they are very delicate and in the famine year the rainfall was not timely.

20. *Q.* Would you say that a district where every 30 acres can be protected by a well is protected from famine?—I think it is protected as far as people who have lands are concerned; yes, I think it is protected.

21. *Q.* We cannot of course protect it from high prices?—Exactly.

22. *Q.* (*Mr. Muir-Mackenzie.*)—Then there is employment for labourers?—In the four south-east districts the population is very dense. In ordinary years I should say the people generally employ more labourers than are absolutely necessary for the work, there is a general feeling of kindness at harvest time. But when prices rise and the people are afraid of scarcity, they are naturally more careful about employing labour.

23. *Q.* (*Mr. Roberts.*)—Wages are paid in kind, not in cash, so the matter of high prices does not touch the labourer, so long as there is work?—In some places they convert wages into cash in a famine year.

24. *Q.* (*The President.*)—Do these wells run dry in a famine year?—Nobody in Sitapur or Kheri has heard of it, and the talukdars say it is unknown; in fact, the water level has been rising. Oudh is intersected by rivers with a perennial supply, the subsoil is very light and sandy, there must be an enormous amount of percolation. The people say that wells will never run dry unless the Ganges and the Gogra run dry. Oudh generally is fairly well protected against famine, I think; in Hardoi there was a great deal of distress; that is a specially precarious district.

25. *Q.* (*Mr. Muir-Mackenzie.*)—Was 1899-1900 a dry year?—Yes.

26. *Q.* I find from my figures that the area irrigated from tanks and other sources was larger a good deal in 1899-1900 than in 1900-1901 in Oudh generally?—I think the Hardoi figures are less accurate than in any part of Oudh.

27. *Q.* (*The President.*)—Is there anything you think could be done for Hardoi?—You bar a canal and you can't have endless wells?—I think we might do a good deal more in wells. But you cannot make wells in a great part of Hardoi; it is pure river sand.

28. *Q.* (*Sir Thomas Higham.*)—Your cultivated area is dependent on tanks?—Yes, and *jhils*; there are no artificial tanks in Hardoi; they made a few in the famine year, but they did not hold water. I would not like to bar a canal in Hardoi, because I don't know enough about it, but I think it would be necessary to be very careful before you did anything in that direction.

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29. *Q.* (*Mr. Muir-Mackenzie.*)—The area under wells seems from the figures I have to have gone up enormously, whereas there has been a drop under tanks?—In the famine year the people made tens of thousands of *kachcha* wells in Oudh.* Government gave large advances. In Sitapur the famine year was the best they have had. The light loam was worked very well; they never had such crops before; landlords and tenants rejoiced in high prices and paid off their debts; there was a smaller area cultivated, but the profits were simply enormous.

30. *Q.* (*The President.*)—This *jhil* irrigation is almost entirely *rabi*?—Entirely.

31. *Q.* Does it give a second watering, or do they trust to the Christmas rains?—They trust to the Christmas rains; there are not many *jhils* which give a second watering.

32. *Q.* Would it be an advantage, if by a canal or by the rains of heaven these *jhils* were filled at Christmas time?—It would make assurance doubly sure.

33. *Q.* Supposing a canal could be brought down into Hardoi, without doing injury, to Shahjehanpur, would it be acceptable to the people, or would they think it a nuisance?—They would not like to pay for it; I think they would be afraid of *reh*; tenants are very much afraid of *reh*.

34. *Q.* Is there much *reh* in Oudh?—No; south of the Sitapur District there is a good deal; from there down to Bara Banki there is a little; large *oosar* plains exist south of Unao There is generally not very much *reh* in Oudh, but the people are afraid of it.

35. *Q.* With your large experience of Oudh, can you suggest anything by which people might be bettered in the way of works as a protection against famine?—I don't think anything is required when you can make *kachcha* wells all over the place for a few rupees. In Gonda and Bahraich water is 12 feet below the surface. I don't believe in interfering between landlords and tenants in Oudh. I don't think Government could do anything except give advances when they are wanted and that they do at present. The Court of Wards have stimulated wells, and some of them are not very successful; it depends on the individual manager.

36 *Q.* (*Mr. Roberts.*)—It depends entirely on him?—In the Kapurthala estate in Bahraich some magnificent wells were made, but not used; even in the famine year the people would not use these wells until presure was brought to bear on them; then they used them a little.

37. *Q.* (*Sir Thomas Higham.*)—Why was that?—They said they did not want irrigation for their maize.

38. *Q.* (*Mr. Roberts.*)—In Sitapur and Kheri a great quantity of the area is grain rented?—Yes.

39. *Q.* Grain renting is usually supposed to indicate a low state of cultivation?—Yes, it does.

40 *Q* How does that affect irrigation? If a canal were made, would the tenants be induced to work other lands or spend their money and labour in making their lands productive?—Grain rents are of course a backward system; there is no doubt that no tenants, or very few, will make a well under the grain rent system.

41. *Q.* What share does the landlord take?—You may say that it comes roughly from one-third to two-fifths.

42. *Q.* One-third to the landlord?—Yes, after making all deductions; it is a very complicated process; I described it in my Settlement Report. It varies from one end of the district to the other; in the north of Kheri the landlord does not get more than $\frac{1}{7}$th or $\frac{1}{5}$th. Where there is no demand for the land the landlord's share is bound to be low.

43. *Q.* But these rents could be converted to cash rents?—I am very much against any attempts to convert from grain to cash; it has been tried several times in Oudh. Sir A. Lyall was very strong on the subject, when the Oudh Rent Law was under revision. I think there are very few people who could do it successfully. I have seen rents converted by a zealous Deputy Commissioner in Sitapur, and the results were not successful; tenants, who howled for cash rents in years when crops were good and prices going up, howled to be sent back to grain directly the famine came, and they were afraid that bad times were coming. There is a big *taluka* in Rae Bareli, where in the famine of 1877-78 the talukdar reconverted from cash to grain at the request of the tenants and has kept to grain ever since It is a backward system, but it is working itself out.

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* *Note subsequently added by witness.*—It was estimated that 550,000 *kachcha* wells were made in 1896-97 in the United Provinces; and that 140,000 of this number were constructed from Government advances.

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44. *Q.* The tendency is to increase the cash-rented area ?—Yes.

45. *Q.* (*The President*)—As regards a village having one well to 30 acres of cultivation, how many acres of irrigation would that have in the year ?—It depends on the well. In Southern Oudh there are 4, 6, 8, 10, and 12 buckets working ; in Northern Oudh you have shall wells in which water is drawn by men and not bullocks. The natives say on the average 10 acres can be irrigated by a well. In Partabgarh in the year of settlement they had 15,522 *pakka* wells and 14,570 *kachcha*, and they irrigated from wells in the year 181,728 acres ; that works out to $5\frac{1}{8}$ acres ; a *kachcha* well works less than a *pakka* well. That is actual irrigation ; there would be an equal area protected, because *kharif* would be on one side of the well and *rabi* on the other ; that would work out to on $10\frac{2}{3}$ acres per well. There would be infinite variations according to the size of the well, depth of the water, position of the well, length of the run to the field, subsoil and nature of the crops. I think from 10 to 15 acres per *pakka* well is protected.

46. *Q.* What do you mean by protection of the *kharif* ?—There is no protection of the *kharif* ; the area under *kharif* one year is under *rabi* the next.

47. *Q.* (*Mr. Muir-Mackenzie.*) In a year of drought the *kharif* would fail ?—Yes, it might ; they could irrigate if they wanted to.

48. *Q.* Would they not work wells in the *kharif* ?—To some extent they do where they grow rice and sugarcane in soil which is not naturally suited to rice and sugarcane.

49. *Q.* (*Sir Thomas Higham.*)—In a break in the rains do they work their wells in the *kharif* ?—Yes, if there is any alarm ; wells never run dry.

50. *Q.* (*The President.*)—Would you say that the best agricultural policy for Oudh in the future is to freely encourage the multiplication of *pakka* wells ?—Certainly. But I don't think you can make wells without limit. Well irrigation in Oudh is supposed to be of very little value without manure ; there is comparatively little manure in the northern districts in comparison with the southern ; in Southern Oudh they all feed their cattle ; there is more human excrement and greater economy.

51. *Q.* The inference is that they must keep up a certain number of cattle ?—Yes, but in Sitapur and Northern Oudh they draw water by hand.

52. *Q.* Would they irrigate as much as 5 acres to a well ?—Yes, 5 to $7\frac{1}{3}$ acres or even more for any one crop is a pretty general estimate. Mr. Hooper, who is a great authority, worked it out and it came to $7\frac{1}{3}$ acres. These figures are taken from the Settlement Report for Busti. (Conversation on some discrepancies in the figures of the Settlement Reports and the figures provided by the Land Records Department.) All these agricultural statistics are only approximate. The Hardoi statistics are very bad owing to the *patwaris* there being bad.

53. *Q.* Do the Oudh tenants readily take *takavi* advances ?—They don't like them much ; they won't take them if they can get money elsewhere.

54. *Q.* Would they sooner pay a higher rate of interest ?—I don't think they look at the interest or the commission which is taken by revenue subordinates ; they look at the repayment ; the difficulty is that the tenants must pay upon a particular date ; the same difficulty exists in Europe.

55. *Q.* (*Sir Thomas Higham.*)—The irrigated area in all these districts forms a very small proportion of the total cultivated area ?—Yes, but then a great part of the northern districts is *terai*—land where irrigation does harm ; the people won't irrigate in the whole of the north of Kheri, and in the whole of the north-east of Sitapur ; there is also *terai* about Bahraich and Gonda ; and in the *terai* water is so near the surface that the land is cold, and the *rabi* if irrigated would rust.

56. *Q.* They don't use wells in these tracts ?—Only on the higher ground for garden cultivation ; the water is only 5 to 10 feet below the surface ; they lift it with *gharras* and levers.

57. *Q.* Would there be any additional cultivation if you made a canal ?—The area which would benefit from a canal is the *bhur* tract along the Gumti ; that is undulating country ; the subsoil is white river sand. They make little wells and they lift out water in *gharras* ; they irrigate very little, but they do irrigate ; a canal would certainly do good there, if it could be worked in such uneven country.

58. *Q.* The spring level would be near the surface ?—Ten to twenty feet, except on the Lucknow border. A canal would only protect the area which is now more or less protected by wells and *jhils*.

59. *Q.* There are no wide stretches of uncultivated land ?—Absolutely none.

60. *Q.* Hardoi suffered very much from drought in 1896-97 ; was that due to *jhils* not filling or was there shortage of rainfall ?—General shortness of rainfall and the *jhils* did not fill A smaller area was sown, because the people were in a bad way ; they had been exhausted by the wet years that had preceded ; 1890 to 1894 were years of heavy rainfall which had hit the district very hard.

61. *Q.* You say, if you took a canal through Sitapur, it would ruin it ?—Yes, I think so.

62. *Q.* You don't think that about Hardoi ?—If you could take a canal through Hardoi without water-logging the centre of the district, it would do good. I am not enough of an Engineer to know if it is possible. You can drain Hardoi into the Ganges.

63. *Q.* The difference between Hardoi and Sitapur is that one can be drained and not the other ?—Yes.

64. *Q.* You would have to drain extensively in Hardoi ?—Yes, and the drainage would have to begin in Shahjahanpur.

65. *Q.* (*Mr. Muir-Mackenzie.*)—Would not the drainage lower the spring level ?—I suppose it would.

66. *Q.* (*Sir Thomas Higham.*)—Would an inundation canal benefit Hardoi ?—I don't know enough about it ; I have never been in a canal district. I don't know whether an inundation canal would do good or harm.

67. *Q.* The idea would be to run one during the *kharif* and fill the *jhils* when there is a deficient rainfall ?—In these places, if you have a big cut, it scours and you get a ravine, but that is an engineering matter. If it could be done without water-logging the centre of the district, I think it would be a very good thing for Hardoi, but I am not competent to give a decided opinion.

68. *Q.* They would not want a canal during the *rabi* ?—

69. *Q.* Provided the *jhils* were filled up ?—They could do as it is in ordinary years and trust to the growth of wells.

70. *Q.* Beyond Hardoi is there any district in which a canal would be beneficial ?—No, I think not. Mr Hooper says—"the only desire evinced by the people is that a canal should not be brought in. This feeling is strong and it is shared by most people who are acquainted with the province"

71. *Q.* You have never known any people express a desire for a canal there ?—I have heard individual tenants in dry villages, where they can't make wells, ask for canals, but the mass of the people in Sitapur and Kheri are strongly opposed to them. They are afraid of *reh* and water-logging. I was in those districts for seven years and know them pretty well. Landlords are opposed to them with very few exceptions, because they honestly believe that they would be dangerous, and of course they don't want to have canal subordinates coming in between themselves and the tenantry. The feeling on that point is very strong and always has been in Oudh. They say it would upset the social system ; but the other feeling is also strong that a canal would produce water-logging.

72. *Q.* That feeling was very strong when the canals were first proposed in 1870 ?—Yes.

73. *Q.* Has it been modified at all as the result of drought ?—I am told that one or two talukdars are in favour of a canal, but there is no doubt that the majority are against it.

74. *Q.* If a canal was made, would it be possible to obtain anything out of the landlords in the form of an owner's rate ?—All things are possible, but all things are not expedient. They would protest and the Oudh talukdars have protested very strongly at times ; it would be a political question.

75. *Q.* I was looking at it simply from an economic point of view ; would their rent be increased to an extent sufficient to justify the imposition of the rate ?—I cannot see how rents can be increased much in the south of Oudh ; they average between Rs. 6 and Rs. 7 an acre over whole districts. In a tract on the border of Sitapur and Bara Banki they average Rs. 8, 9, and 10 an acre for the whole village.

76. *Q.* (*Mr Muir-Mackenzie.*)—On irrigated land ?—No, but the land does not require it ; they grow sugarcane without irrigation ; it is very fertile soil ; perhaps there is something peculiar in the soil.

77. *Q.* (*Sir Thomas Higham.*)—You don't think there would be such a great increase in the productive value of the land as to justify a rate on the owners ?—No, and water-rates would be very unpopular.

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78. *Q.* Apart from water-rates would it be possible, do you think, to do as we do on other canals where we take something out of the owner?—I think not.

79. *Q.* A water-rate would have to be levied if we made a canal; would the people take the water?—Water-rates would be unpopular in Oudh, because they are quite contrary to the custom of the country; there are no wet and dry rates; the rent is a lump rent; a man may have one anna on the rupee as legal enhancement; it is put on all land equally. People would regard it as *zulum* to assess them specially for water; one or two talukdars have tried to put on a rate for tank irrigation, and the tenants have immediately complained.

80. *Q.* If you made a canal and brought water to the land in a season of drought, would not the tenants be glad to pay?—They would pay of course in years of drought, but a water-rate would be unpopular in ordinary years.

81. *Q.* The qustion is whether they would take water if they had to pay?—No; not if they could get water from wells.

82. *Q.* We could not make them pay unless they took water?—They would say—you have drained our *jhils* and should give us the water free.

83. *Q.* A canal would save the expense of lifting?—Yes but it takes a long time for them to change their customs; if they could get water anywhere else, I am perfectly certain that the vast majority would not touch canal water, because of these rumours that canal water chills the land and produces *reh*.

84. *Q.* (*Mr. Muir-Mackenzie.*)—You wish that a stimulus should be given to the digging of wells?—I don't wish much stimulus given, because I don't think it is very wise; they are working up gradually. In the old days in the Court of Wards a Deputy Commissioner sometimes stimulated the digging of wells with rather ridiculous results in some cases. We can take borings, but the borings are not very well done, and the natives prefer their own methods of finding out whether there is water; they have one method in Kheri which I have seen work very well; little saucers of water are placed on the ground; if they are found to be filled with water in the morning, they say there is water underneath; if they are dry, then they believe there is no water. In the Court of Wards Manager's bungalow at Lakhimpur they had a man who took a boring for a well; after spending some hundreds of rupees on it he got to sand and the thing was useless. The gardener tried the method I spoke of and not 20 yards away found a spring, and a *kachcha* well which cost a few rupees has watered the whole compound ever since. Some old *Kurmis* are supposed to be able to say from taking up a handful of earth whether there is water underneath.

85. *Q.* Mr. Hill, Manager of the Court of Wards, seems to have been very successful?—It is a matter of individuals. In Cawnpore and Moradabad Government tried after the famine of 1877 to start wells and put on selected officers, but zamindars would not take them over when made. Government spent Rs. 25,000.

(*Mr. Roberts.*)—We don't, I think, get full information of failures in the Court of Wards estates.

86. *Q.* (*Mr. Muir-Mackenzie*)—If you have a special man, could the thing be done?—I think "facilities" should be given, but I am against "stimulus."

87. *Q.* By stimulus I was really alluding to such things as the liberal provisions of advances?—I entirely agree that advances should be given.

88. *Q.* That the people, instead of being left to themselves, should be pushed and should have the advisability of taking these advances pressed upon them?—There the personal equation comes in; it depends on who pushes them; if you told the tahsildar to push them, he would say '*jo hukm*."

89. *Q.* Do you mean that the tahsildar would be likely to stimulate people who didn't want the money to make wells?—Yes.

90. *Q.* And to make wells where they were not really required?—Yes, in the famine *takavi* was given; it had to be given very rapidly, and there is no doubt that a lot of the wells made have not since held water; also in the old days of Oudh some of the Deputy Commissioners used to stimulate well construction, and you see many of the wells are now without any water in them.

91. *Q.* Were they made from advances?—Yes, many of them were.

92. *Q.* If places for wells were ascertained by means of a boring beforehand or in any other way, so that mistakes might be avoided do you think it would be unsafe to push the matter?—If risks could be avoided, certainly not.

93. *Q.* Would you not go further and, with the object of extending wells, take a certain amount of risk?—Not in Oudh.

94. *Q.* Your remarks are restricted to the particular conditions of Oudh?—Yes, almost all my service has been there.

95. *Q.* You said a great deal of money was spent in the famine on *kachcha* wells?—Yes.

96. *Q.* Was that principally out of advances?—Yes, advances from Government and landlords.

97. *Q.* Principally from Government advances?—Yes.

98. *Q.* Did money-lenders refuse to come forward?—I don't think they could have been said to refuse to come forward; they gave a lot of money, but it was an exceptional occasion and a great deal more money than usual was required. I should say, speaking roughly, that the additional amount was mostly provided by Government on that occasion.

99. *Q.* You don't remember how much it was?—I am afraid not.

100. *Q.* (*Mr. Roberts.*)—What does a *kachcha* well cost?—It varies from Re. 1 to Rs. 6 in Sitapur; in the south of Oudh it is from Rs. 5 to Rs. 30.

101. *Q.* Relatively to the total cost of cultivation a *kachcha* well is only a small proportion?—Yes.

102. *Q.* So that the cost is often met by the people themselves?—Yes, the people made thousands of wells themselves on their own initiative and thousands more were made by Government assistance.

103. *Q.* (*Mr. Muir-Mackenzie.*)—In the famine were there *kachcha* wells mostly made out of Government assistance?—I think the people themselves made more than Government made for them.

104. *Q.* Was a very considerable proportion made out of Government advances and which could not have been made but for them?—A very considerable proportion was made out of advances, and I suppose could not have been made without them.

105. *Q.* What was the procedure adopted in making these advances?—The ordinary procedure was too slow, and so the Pargana Officers were sent out; they obtained lists of people requiring *takavi* for wells from *kanungos* and tashildars and landowners and shovelled out the money as fast as possible.

106. *Q.* Did they take money with them?—Yes.

107. *Q.* Do you think it would not be a good thing to adopt that procedure in ordinary times?—You would lose a lot of money unless you had careful enquiries. The dishonest people, if they thought they could get the money direct from the Sahib on the spot, would not make all the wells they had taken advances for. You have to look at the register to see whether the land is actually owned by the man or if it is mortgaged; you cannot do that in the village.

108. *Q.* A great many officers have been in favour of this procedure on the ground that it is precisely in the village that these particulars can be promptly and accurately ascertained?—You could do it when it is exceptional, but if it became the rule, it would be very difficult.

109. *Q.* There was an officer in Bengal who was rather successful and he went entirely on these lines?—It depends so much on the person. I should like certainly any simplification of procedure that can be made without undue risk.

110. *Q.* Do you think the Government will fail to recover a large proportion of these famine advances apart from what they have decided to remit?—I think they have recovered all.

111. *Q.* That would show there has been no particular risk run in spite of everything?—They have wiped out a good deal.

112. *Q.* The Government decided from the first, I suppose, to remit a good deal?—Yes, but you know how these things are done; perhaps Rs. 10,000 or Rs. 20,000 cannot be traced and that all comes in under remissions.

(*Mr. Roberts.*)—Remissions were not made till some time after the famine was over.

113. *Q.* (*Mr. Muir-Mackenzie.*)—Do you think the provision as regards exemption from enhancement stands in any need of revision?—In view of the figures of well construction in Oudh, I can hardly advance anything in favour

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of a permanent exemption for improvements. I cannot see that it is necessary in order to get improvements, but I think it is very desirable as a part of our settlement policy.

114. *Q.* Why is it desirable?—Because I think that all round in the United Provinces and Oudh we are taking at each successive settlement a smaller and smaller percentage of the actual assets. If you are doing that and at the same time you can encourage improvements, it is a very good thing. Also I think that most Settlement Officers will agree that, so far as there is a defect in our settlement system, it is that a man who works up his village at the end of the settlement is liable to find that his revenue will be enhanced more than that of the person who has left it alone. We guard against that as much as possible; but, as a matter of fact, you cannot make allowances for all improvements.

115. *Q.* (*Mr. Roberts.*)—Is it logically and equitably necessary that it should be so? (Illustrated by an example in which a landlord's rent is Rs. 100; he makes an improvement and raises the rent to Rs. 50 more; the question was asked why the whole improvement should go to the landlord.)—Nobody can say that the present rules are not liberal and equitable, and, in view of the figures of well construction, it would be, as far as well protection is concerned, unnecessary to make them more liberal than they are in these districts; at the same time I think the more liberal you are at the settlement the better. There is no doubt that the improvement allowances given at the settlement were not as great as Government intended them to be. Settlement reports show that Settlement Officers did not allow for improvements in the earlier settlements of Oudh to the extent which later we did allow. In the Lucknow report there is a passage "Landlords merely regard the sinking of wells as a ground for enhancement of revenue at the next settlement. Such considerations have materially interfered with the construction of wells." That may be the case in Lucknow, but I don't think it is the case generally. As the figures show an enormous number of wells have been made, and there is not the slightest doubt that the landlords did not know anything at all about the improvement allowances that were notified in the Board's circular. When I went to Sitapur I heard a report at the beginning that a landlord was covering over his wells in view of settlement proceedings. I issued a notice to them to file their claims to allowances for improvements and then they came in thousands. A great many allowances were made on appeal by the Settlement Commissioner.

116. *Q.* (*Mr. Muir-Mackenzie.*)—Do you think they understand that allowances have been made and will in future be made to them?—I think so; but you cannot answer for 30 years hence.

117. *Q.* What happened in the settlement altogether, was there an enhancement or reduction?—There was a large enhancement.

118. *Q.* You don't think the effect of that general enhancement has obscured the fact that they had some improvement allowances?—No, because they got so many allowances on appeal.

119. *Q.* We heard in the Central Provinces that the zamindars said "you say I have an bad allowance made for my improvements still I find an enhancement; it seems that is not the case." Is there not a tendency to say that?—There is a tendency to say it, but I don't think they believe it.

120. *Q.* (*Mr. Muir-Mackenzie.*)—You say there is no distinction between dry and wet rate in Oudh?—In all the settlement reports there are no distinctions. In local areas you can sometimes find something like them. For instance, the rents in a tract where wells cannot be made would be lower than where wells can be made, other things being equal.

121. *Q.* The tenant in Oudh has no enhancement of rent ever placed upon him in respect of his improvement?—I should not say "ever," but the rule—certainly in every district I know and I believe in every district—is to take the enhancement of rent on all the tenants at one time and at the same rate. If the landlord wants to get anything out of his tenant for a well or improvement, he will have a *nuzzur* then and there, if he thinks the tenant can pay it. That is their way.

122. *Q.* Can any steps be taken to prevent the landlord getting that *nuzzur* out of the tenant—any practical steps?—No. Any time the Government has attempted anything of that kind it is passed on to the tenant. You cannot stop it. A great many landlords do not do it. I think the majority of the landlords of Oudh treat their tenantry, as a rule, very well, as well as any landlords in the world, but you cannot stop the men who do it.

123. *Q.* You do not think it a feasible measure that may eventually stop it to declare it illegal?—No; it would be futile and inadvisable.

124. *Q.* Can a man sue for it?—No.

125. *Q.* In order to enable advances to be made to tenants for wells, would it be advisable that they should be given any transferable interest in their land merely for that purpose?—You cannot in Oudh, because of the *sanads*. We say we maintain the status at annexation. Lord Lawrence tried to introduce tenant right into Oudh and failed.

126. *Q.* I am alluding to, I think, Mr. Molony's proposal, which is that merely for purposes of *tukavi* advances; he proposes to legislate to give the tenant a transferable interest if his landlord refuses to make the improvement?—I do not think you can create any new rights in Oudh without a great deal of trouble, and I do not think they are required.

127. *Q.* Then what security will you get from the tenants?—They have the security of groves, bullocks, carts,—personal property.

128. *Q.* Will that security be sufficient for one owner?—They generally have collateral security too. It is no difficulty to get it from a good tenant. Many of the improvements are made by *Kurmis* who co-operate very much amonsgt themselves.

129. *Q.* Do several people ever combine to take advances or wells?—Yes.

130. *Q.* Can you give me any opinion as to any measures it might be advisable to adopt for getting into the famine programme works more useful for irrigation?—I cannot give you any general opinion about that. I have served in districts where we do not want works for irrigation.

131. *Q.* (*Mr. Rajaratna Mudaliar.*)—Was the large increase in the number of wells since the last settlement due in some measure to a series of unfavourable seasons, or was there any special cause?—The large resort to well-making was chiefly the result of peace and prosperity which followed the introduction of British rule in Oudh. At the last settlement it was noticed that the tenants had begun at once to make wells, and now they are going on steadily.

132. *Q.* (*Mr. Muir-Mackenzie.*)—They did not stop before the revision of settlement?—I do not suppose they made so many, but they did not stop actually. The movement slowed down, no doubt; but it is going ahead again fast now, I am told.

133. *Q.* (*Mr. Rajaratna Mudaliar.*)—Do you think the extension of wells would have been still further stimulated if more liberal terms had been granted in the way of exemption?—That is rather hypothetical; in a few cases, no doubt, people would have made wells, who have not made them; but in face of these figures I do not think you can say that more liberal exemption in Oudh would have led to a much larger well construction. I am in favour of liberal exemption of improvements, but I cannot, in the face of these figures, allege that the present rules have deterred improvements.

(*Mr. Rajaratna Mudaliar.*)—In the Madras Presidency there is permanent exemption and the result is marvellous.

(*The President.*)—Have you anything in Madras to compare with this?

(*Mr. Rajaratna Mudaliar.*)—Yes.

(*Mr. Muir-Mackenzie.*)—In Coimbatore they have some wanderful wells.

(*The President.*)—I have not seen a record of I *pakka* well to 30 acres of cultivation.

(*Mr. Rajaratna Mudaliar.*)—We have two or three waterings every week in Madras.

(*The President.*)—Is there any place in Madras with a *pakka* well to every 30 acres?

(*Mr. Rajaratna Mudaliar.*) In Hardoi there has been a decrease of population; was it due to the famine?—Mr. Burn, the Census Commissioner, is here, and will tell you about that. I should say the wet years before the famine had a great deal to do with it.

134. *Q.* If the area irrigated from a well amounts to 26 per cent. of the cultivated area, and you say the wells do not give out during a drought, why should the population suffer such a great loss as 20,000 in ten years?—The district had had four years of flooding, which ruined the people

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and then on the top of that it had a very bad famine. It has a dry tract as well as a wet tract—one sand and one clay.

135. *Q.* Will not the people irrigate the *kharif* even in a dry year?—They do when they want it; if it is a great drought, they irrigate their corps, especially rice in the *kharif*.

136. *Q.* Could 50 per cent. of the area be protected by well where *kachcha* wells can be made?—Yes, but they do not irrigate a large area— 2 to 3 acres in Hardoi.

137. *Q.* Is there a large area of rice under wells?—No, on the Nepal border there are large rice tracts; and the rice is commonly grown in tracts near rivers and in depressions near *jhils*.

138. *Q.* In your settlements did you grant exemptions where the improvements were not registered beforehand?—Yes. There were no registrations in Sitapur and Kheri, and I gave very large allowances indeed. The people did not know of the order to register.

139. Q. What was the amount of abatement given in Sitapur?—Over a lakh. It is largely a grain-rented tract, and in a grain-rented district the landlord does everything. Since last settlement at Sitapur they have made an enormous number of new hamlets and brought land under cultivation. For all these I made very liberal allowances,—so liberal in fact that I could hardly justify them except for the enhancement I took, which was 30 per cent. Government wanted a moderate settlement in Sitapur as elsewhere, and they passed my allowances without any objection.

140. Q. (*Sir Thomas Higham.*)—A very small proportion of that was on account of wells?—Yes.

141. Q. (*Mr. Rajaratna Mudaliar.*)—That assessment was in respect of landlords?—Yes. The estimated enhancement of Sitapur was 60 per cent. That was made on the figures. One had to reject many figures and make allowances for precarious tracts.

142. *Q.* (*Mr. Roberts.*)—Sixty per cent. includes new lands under cultivation?—Yes.

143. *Q.* What allowance was given for improvements?—In the whole of Southern Oudh a large portion of the allowance was given on appeal or in revision. Altogether I should say that at least 5 lakhs, and probably as much as 7 lakhs had been allowed for improvements in 11 districts in Oudh. In the twelfth they are, I believe, making very liberal allowances.

144. *Q.* (*Mr. Rajaratna Mudaliar.*)—What was the amount of reduction to tenants?—Tenants do not get allowances at settlement.

(*Mr. Roberts.*)—We do not get into relation with the nants at settlements.

Mr. W. H. Moreland.

MR. W. H. MORELAND, Director of Land Records and Agriculture, United Provinces of Agra and Oudh

(*Lucknow, 27th November 1902.*)

1 *Q.* (*The President.*)—You have an expert well-sinker attached to the department. Do you find much work for him?—He was only appointed a year ago and hitherto he has had more than he can do.

2. *Q.* Has he trained any others under him?—He has subordinates to do boring, but he is not at present training any school of engineers in special work. My intention is that, if the demand for his services continue, we shall get a young overseer to be trained by him as his assistant.

3. *Q.* (*Mr. Muir-Mackenzie.*)—He is a Public Works man?—Yes; he was working on bridge building. Then he had a special training at Roorkee. I mean to wait on the demand.

4. *Q.* (*The President.*)—Would it not be a good thing to start some others as soon as possible?—I cannot say that the demand is not temporary. This man has been lent to examine the drinking wells in the Terai. He is now going down to the south of Mirzapur to try some of the rock wells. I cannot say whether there is work for one man or five.

5. *Q.* It seems very important that well-sinkers should get advice of this sort. We have had a great deal of evidence, in the different districts, of the trouble that arises from mistakes in sinking wells; and there has been a proposal that at the head-quarters of each district there should be boring tools available?—That was tried by our department in 1884. I cannot find where those boring tools are now; perhaps in the District Engineer's godown. I should object to leaving tools about if there is no man to look after them.

6. *Q.* Do you know how much the tools cost?—A set costs about Rs. 300.

7. *Q.* Can you not get them cheaper?—With the system of boring, under which we work at present with iron pipes, that is the cheapest we can get them for. But the Deputy Director of my department, who has had American experience, says that it can be done much cheaper at any rate to 30 or 40 feet, with an ordinary augur, without the pipes, and we are working out the details of that. In that case it would not cost more than Rs. 150 at the outside.

8. *Q.* We have been struck in our evidence of Oudh with the immense number of wells. In the Rae Bareli district there is one for every 30 acres. Is there any limit to that, when will they begin to interfere with one another?—We have not reached the limit yet. I have been working out the districts that have the largest number of wells. Fyzabad (Pachhim Rathi) had 22½ wells to every square mile in 1897. There was no complaint of the wells running dry. It is a dampish district. Barabanki (Hyderganj) had 17.

9. *Q.* Are these mostly recent or old?—The increase goes on steadily. The wet years, which ended in 1894, seem to have had the effect of diminishing the rate, but we have not got the figures for the 80's. In the beginning of 1896 there was a rapid extension, which again shows signs of a falling off.

10. *Q.* Do you think that this natural extension of wells is enough, or that we should try to stimulate it by giving greater facilities for *takavi* loans?—The latter are not much availed of apparently,—not as much as they might be. I think the delay in getting the loan is the thing the people most object to.

11. *Q.* If there were some simple, easy procedure for giving loans, more might be taken?—I do not say it would make any very great difference, but it would be an aid to the people.

12. *Q.* So far, I think, our Commission must come to this conclusion about Oudh; that wells and *jhil* (tank) irrigation is the only mode of irrigation they wish to have. Public opinion seems to be very strong against any great canal scheme?—Public opinion was very much against it in Barabanki.

13. *Q.* Therefore there is the more reason to encourage the cultivators to extend *pakka* wells?—They must depend on *pakka* wells putting aside the Sardah Canal.

14. *Q.* What is your opinion as to the area commanded by a well in ordinary circumstances?—I do not think it possible to give an estimate for the Provinces: the well-irrigated area last cold weather showed that in some cases 3 acres were irrigated per well; in others 7.

15. *Q.* Have you experience of a canal irrigated district? I have been all through the centre of the Agra Division, and I have been Collector of Bulandshahr.

16. *Q.* Twenty years ago there was a strong feeling on the part of revenue officers of the mischief done by over-irrigation, and we were encouraged to keep irrigation down to about 30 per cent. of the actual village lands. From our inquiries at Allahabad it seems that that feeling has passed away and that a village may have 80 per cent. of village lands irrigated without any harm?—It depends entirely on the circumstances of the individual village. If you have a village or a large area of fertile low land, it may be very unsafe to irrigate 25 per cent. of it. But with a village with very little low land, it would be perfectly safe to go to 40 per cent. in any single year; that would be 60 or 70 per cent. allowing for rotation.

17. *Q.* Is there any chance of the villagers reducing their grazing grounds for the sake of getting irrigated crops?—There is practically no grazing ground in irrigated districts now.

18. *Q.* That is very serious; is it not?—It is serious in a way, but it is a question of turning the available land to the best advantage.

19. *Q.* Have you known of a case of land which had become water-logged or covered with *reh* being restored to cultivation by drainage?—I have seen no case. But the Kali Nadi valley in the Bulandshahr district has large areas cultivated which used to be covered by *reh* before the channel was deepened. In the Unao district in the year 1893-94 when I was doing settlement the villages along the Sai river were completely water-logged and had to have their revenue reduced in some cases by one-half. The low

Mr. W. H. Moreland. lands were covered with *reh.* That is all under cultivation again now.

20. *Q.* There was no drainage work?—No drainage was done. That was a case of the stream being unable to do its drainage work in the wet seasons. It was the series of wet years in 1891-94 which started our calamities.

21. *Q.* Have you had experience of *kans* grass in Bûndelkhand?—I know nothing special about it. I have an experiment in hand but it is not far enough on to say anything about it.

22. *Q.* Have you seen any irrigation at all on black cotton soil?—Rarely.

23. *Q.* You have heard the general opinion expressed that irrigation is not suitable for that soil?—Yes.

24. *Q.* Do you think the feeling is general throughout Oudh against the Sardah Canal?—So far as I have had an opportunity of judging.

25. *Q.* Does your own judgment go along with the general opinion?—I am not very sure about the alignment; but so far as it goes into Barabanki, which I know, it would be very nearly useless, and it would certainly interfere with the existing well system.

26. *Q.* Would the result not be that men would give up their wells and take to it. In the beginning of the irrigation of the Doab irrigation was deliberately taken into the well tracts, because it was thought that people understood irrigation and would take to it, and in fact the wells were given up to a very great extent?—I think the Oudh cultivator is more likely to stick to his well than the North-Western. He is a harder worker.

27. *Q.* He is a wiser man than his brother across the Ganges?—I certainly think he is, but perhaps I am prejudiced in his favour.

28 *Q.* (*Mr. Muir-Mackenzie.*)—As to the number of wells, we have been given by Mr. Hooper and Mr. Butler statistics showing that wells have enormously increased in certain districts of Oudh since the last settlement and your figures do not agree with those. Mr. Butler gives us 7,609 wells in Hardoi and your figures only, say, 1,100 *pakka* wells?—My figures are those returned by the local records staff for the statistics of the Government of India. They come from the district officers. The classification of half-masonry and masonry wells is always doubtful.

29. *Q.* But even if you take the half-masonry wells from what Mr. Hooper gives, that would come to 6,000. Are there any other deficiencies?—Possibly Mr. Hooper included wells for the supply of drinking water.

30. *Q.* No, Mr. Butler was most careful to speak of *pakka* wells only?—At the last settlement wells in village sites used only for drinking water were not enumerated separately from wells used for irrigation. The village accountant sends the figures to the circle officer, who checks 7 per cent. and a certain amount is checked by superior officers too.

31. *Q.* Is the latter check complete?—It is not.

32. *Q.* I suppose the district officers have not much time to do it?—There is always some other special work every year and the ordinary work has to go.

33. *Q.* How many *kanungos* to a *tahsil*?—There is 1 to about 45 *patwaris*, so there will be 3 *kanungos* in a *tahsil*, or 4 or 5, as the case may be.

34. *Q.* But even if the check is not as full as you would like it to be, that would not account for the very large discrepancy?—Unless there had been some mistake of compilation in the district officer.

35. *Q.* May we take it that the life of a masonry well is infinitely long?—There is a very steady disappearance of masonry wells. I do not think you can say that they are quite permanent.

36. *Q.* Does the *kachcha-pakka* well last as long as the *pakka*?—Not in ordinary cases; the *kachcha-pakka* well is the cheaper expedient.

37. *Q.* How much does it cost?—I have been told that it costs a half to two-thirds of a *pakka* well of the same size, but that is a very general estimate.

38. *Q.* Is it enough to make it worth while to make advances for it?—I think so. If a cultivator wants to make a permanent well, he makes a *pakka* well. A *kachcha-pakka* well is the cheaper expedient in place of a *pakka*, and a *kachcha* well is the first expedient.

39. *Q.* As to areas irrigated you cannot give separate details for *kachcha* and *pakka* wells?—The area depends on many features; the strength of the cattle and the size of the bucket affect it.

40. *Q.* Mr. Gillan told us 50 *bighas* were irrigated from one *pakka* well in Meerut?—That must be with big cattle.

41. *Q.* The Court of Ward's Manager from Aligarh told us 50 acres for a six-bucket well. The size of the cattle will not account for that difference?—No. I think, if you look at the figures, you will see that I am not justified in giving any average. In districts lying side by side the difference varies from 3 to 8 acres. Eventually we put it at about 8 or 9 acres. That is one of the conventions of the statistics of the Government of India.

42. *Q.* For settlement purposes?—The Settlement Officer sees how much each well is doing. He has to allow for the improvement for each individual well. The settlement statistics are the ordinary statistics prepared with a little additional care.

43. *Q.* Is not that additional care an important matter in that case?—I think it is. My own personal test of papers in the last four years showed the error comes to 5 or 6 per cent., and the settlement might reduce it to 3 per cent.

44. *Q.* Presuming that there has been a large increase of wells since the last settlement, when did it occur?—I cannot tell you—before 1890.

45. *Q.* With regard to the increase in the famine year, would a cultivator ordinarily have time to get a *pakka* well built in order to be of use to him in a famine year?—I think the wells were hurried up. There is plenty of labour to be had, and a good many wells were used when they were quite incomplete.

46. *Q.* This rather negatives the view, which has never been mine, that it is no good to make advances for *pakka* wells in famine years. Were you Director at the time of the famine?—Temporary Director for six months.

47. *Q.* I suppose you are opposed to the idea of Government constructing wells?—The experience in the Moradabad district was distinctly against it.

48. *Q.* Still has it not been the case that with the Court of Wards a certain amount of success has been obtained?—The success has been greatest when the Court of Wards has given the tenants all the help they could and left them to make the wells.

49. *Q.* I am ready to admit that, but can you say that the other course has not been successful on the Court of Wards Estates? Does not a good manager succeed?—A good manager succeeds. My feelings are no doubt rather coloured by the great number of useless wells I have seen built by the Court of Wards in one district. What I feel about Government management is that the advantage of Government taking up any work gets smaller as the work gets smaller.

50. *Q.* Put it might be better to try Government work than nothing at all in places where people are backward?—I would always much prefer to advance the money to any people who would take it up.

51. *Q.* And if the people are backward?—If the people are too backward to make wells, they will be too backward to use them.

52. *Q.* Even when the well is put down in the place and its usefulness is shown before their eyes?—I do not know of any such case in these provinces.

53. *Q.* Mr. Molony has recommended to us a general survey of the levels of the *mota*, so as to map out the *mota* tracts; do you agree?—Colonel Clibborn made an outline map of the distribution of the *mota*. It might be worth while to survey villages lying along the edge of the *mota* as shown in the outline.

54. *Q.* Would it be unsafe to push advances until a survey had been made?—I should not put off advances.

55. *Q.* Would you have this sort of work—the survey of the *mota* and the investigating of conditions favourable to well-sinking—all left with the present agency?—The way to work it would be for two or three experts when they have time to work out a dozen villages or so at a time.

56. *Q.* So far as it affects irrigation, could it not be entrusted to the Irrigation Department?—They have not officers on the spot.

57. *Q.* They would have to get them?—They are more competent to do it than anyone else.

58. *Q.* Do you think that a staff is wanted?—I doubt if there is room in these provinces.

59. *Q.* What is the reason that the people give for their objection to canal irrigation in Oudh?—They say that it will raise the water level, depreciate the low lands, and affect the health of the district, and they do not want any more Government subordinates than they can help.

60. *Q.* You allude to the area of the Kali Nadi as an instance of the beneficial effect of drainage in decreasing

Mr. W. H. Moreland.

rek. Do you know any instance in which drainage has had the opposite effect,—the effect of so lowering the water level that lands have gone out of cultivation?—I have had a report from the west of Aligarh district to the effect that the water level had sunk so low that the wells could not be used for irrigation. I have not seen any case myself.

61. *Q.* It has been suggested that drains should all have regulators, so that besides being of use in a wet year they would hold up water in a dry year by shutting up the outlet of the drain and keeping the water in?—It would be a very useful thing if it could be done without friction; but it would be likely to lead to a good deal of friction between owners along the different parts of its length. I put that before the Irrigation Department in 1896.

62. *Q.* What became of the suggestion?—I do not know.

63. *Q.* (*Sir Thomas Higham.*)—It has been suggested that something might be done for the Hardoi district by making an inundation canal, taking it out at a point high up on the Sardah?—I do not know the Hardoi district personally.

64. *Q.* The idea is that it would be of use in filling up the *jhils* in a very dry year. It would not give a regular irrigation supply like a permanent canal?—I really do not know enough about the district to give an opinion of any value.

65. *Q.* (*Mr. Rajaratna Mudaliar.*)—Is any great technical knowledge required for using boring instruments?—Not very much, but practice.

66. *Q.* I suppose your overseer would be able to train a sufficient number of people?—Quite easily.

67. *Q.* Does the area irrigated per well represent the area commanded or the area actually irrigated?—The area actually irrigated in one year.

68. *Q.* Mr. Palmer has given us a statement of weather figures. He says he has consulted you on the subject. Would the statement afford reliable data for taking action? It is a sort of scarcity barometer?—It is a thing you would have to use with a great deal of care.

69. *Q.* (*Mr. Muir-Mackenzie.*)—Am I correct in understanding that there was no very great failure of the *rabi* in 1896-97?—The *rabi* that was sown was a good crop. Some crops were damaged; gram suffered a good deal.

70. *Q.* There is not much experience of any extensive failure of *rabi*?—No, the areas sown were small, but that is a different thing.

Mr. G. P. Gartlan.

Mr. G. P. Gartlan, Estate Agent, Rae Bareli.

(Lucknow, 1st December 1902.)

1. *Q.* (*The President.*)—Yours is a district where well irrigation is the main thing?—Yes.

2. *Q.* Is anything else needed to protect that part of the country from famine?—Extension of the wells would be quite sufficient.

3. *Q.* You could not rely on *jhils* in a bad year?—For rice land we could not, and wells would not save the rice. In ordinary years the *jhils* are quite sufficient; in a year of drought they are not; wells do for *rabi* and *kharif* both, but mainly for *rabi*.

4. *Q.* Do you consider that a canal would be a positive harm to the country?—I have had no experience of canal irrigated land.

5. *Q.* Across the Ganges Canal irrigation is taken up everywhere?—The talukdars object to the canals, because they do not want interference with their tenants. It is not a question of the benefits of the canal, because there are places where it would be beneficial.

6. *Q.* Did you see any severe distress in the famine seasons?—Not in Rae Bareli, except in rice tracts.

7. *Q.* Was there any relief in Rae Bareli?—Yes, on roads.

8. *Q.* Do the cultivators get a *rabi* crop after rice?—*Jarhan* rice lands will not give a second crop often, even with watering.

9. *Q.* Do the zamindars and cultivators take *takavi* readily?—It is with great difficulty they get it. They are put to much trouble, and they have to pay over 10 per cent. for it.

10. *Q.* (*Mr. Roberts.*)—To whom?—The *kanungo* who is sent to make an investigation gets something. The man who distributes the money gets something, and the *amlas* get something. The *patwari* probably gets something too.

11. *Q.* Do you really think it amounts to 10 per cent. for large advances to dig wells?—Not for anything over Rs. 100.

12. *Q.* But advances for *pakka* wells would scarcely be less than Rs. 250?—I expect he would pay 10 per cent. on that, because he does not get it in one lump sum. Every time he goes to get his 50 or 30 rupees, he has to pay. I have heard this from people who have paid it themselves. There are very few advances made in our district for wells; they manage to get the money for wells elsewhere. If the talukdars and zamindars did not interfere with the people, they would dig many more wells; but the landlords will not allow them, because they are afraid of the tenants getting a right.

13. *Q.* Big or little landlords?—Both.

14. *Q.* A very large talukdar whom we have examined says that he never refuses permission?—They may say so. They want a *bazdawa*, or adandonment of claim for compensation, but under the Oudh Rent Act that is waste paper.

15. *Q.* (*The President.*)—Is there any way of promoting the construction of wells?—Yes, I make advances to my tenants who are willing to make wells and charge them a certain interest. I do not take back the money, but put it as a permanent increase on the man's land; and the Court of Wards has been doing the same thing for the last few years on my suggestion.

16. *Q.* You practically pay for the well and get an increased rent?—Yes.

17. *Q.* You find that that system works well?—Yes.

18. *Q.* If something of that sort were introduced, would it be popular?—It would be popular among the people building wells, not among the landlords. But still the landlord would have no reason to complain.

19. *Q.* He has a right at present to forbid a well?—No, he cannot prevent it. If he will not allow it, the tenant can go to the Deputy Collector and get an order for the well to be built; and if the talukdar will not build it, the tenant is allowed to do so; and if the landlord ever interferes, he has to pay compensation for the capital spent on it.

20. *Q.* (*Mr. Muir-Mackenzie.*)—But it is not a good thing for the tenant to bring himself into bad relations with the landlord?—No.

21. *Q.* (*Mr. Rajaratna Mudaliar.*)—Are the rules understood by the tenants?—Partially. Some know them better than the vakils.

22. *Q.* (*The President.*)—Do you find that the rate of Government interest for advances is complained of?—No; but when all the commissions are added on, it comes to more than they can get it for in the open market.

23. *Q.* (*Mr. Roberts.*)—Can you suggest any way of stopping that leakage?—If you put the interest of the money advanced in to increased rent and let that come direct into the Government treasury as revenue, that would stop it.

24. *Q.* (*Mr. Muir-Mackenzie.*)—Not take back the money?—No.

25. *Q.* But the leakage would go on when the money was being distributed?—For a time, but there would not be the same leakage. Now the man pays not only when he gets the money, but when he repays it. Wells can be built much cheaper by the *kashtkars* than by anybody else, even *pakka* wells.

26. *Q.* (*Sir Thomas Higham.*)—You do not think that canal irrigation is required at all in your own estate?—I do not think so.

27. *Q.* Is the whole area commanded by wells?—Almost all the *rabi;* not the rice. There are lakhs and lakhs of money invested in wells; and if the canal came, the wells would be nowhere.

28. *Q.* Does the rice depend on the rainfall?—And on irrigation from the tanks. The September rice generally comes round with the rain alone, but the *jarhan* rice requires to be irrigated.

29. *Q.* If a canal were introduced, it would not increase the value of your property very much?—I do not think so.

30. *Q.* Are they going on making wells?—Yes, year after year in my district. The Opium Department give them great assistance.

31. *Q.* I suppose the opium agents go out amongst them?—Yes, and there is not the same amount of bother in getting the money as with Government advances. The only trouble they have is the investigation as to whether the man is fit to build a well.

Mr. G. P. Gartlan.

He has not to go to *kanungos*. I am not sure whether they charge interest. I believe the same is re-payable within two years.

32. *Q*. I suppose on all the wells of the Opium Department the cultivators grow a good deal of poppy? But that is only a fourth of the irrigation from the wells.

33. *Q*. Do the Opium Department make them undertake to grow so much poppy? No; but he must cultivate some. It is only in the case of his being a poppy-grower that a man gets the advance. After one or two years he can give up poppy, and the Opium Department can do nothing. But it does not matter, for they have their advance back.

34. *Q*. Is there much poppy in Rae Bareli?—I suppose it is the best district in the country for poppy. They can get something like 15 or 16 seers from the acre. It sells at Rs. 6 a seer; and Rs. 8 a *bigha* are advanced on the land sown with poppy.

35. *Q*. You were in Rae Bareli in 1897?—Yes, I have been there 36 years.

36. *Q*. How did you get on?—All the crops were fairly good except the rice.

37. *Q*. Was that the worst year?—Yes. In 1877 it was bad, but only for rice.

38. *Q*. Is rice a large proportion of the cultivation?—No, but it is very localised. Where it is rice it is all rice, and thus it suffered very much.

39. *Q*. They had a considerable number on relief works?—Yes, mainly from rice districts, but not all Rae Bareli people.

40. *Q*. Do not the people who grow rice grow *rabi*?—Yes, but on a very small scale. The *rabi* is very poor. I believe the wells are all right in an emergency. The people believe very much in *pakka* wells.

41. *Q*. They were very badly off in Sitapur in the famine?—They have very few wells there, and it depends on the distance one has to go to get water. In Rae Bareli we do not look upon the well as the unit of irrigation; we look upon the bucket, and it is the same irrigating from a tank the *doogla* or basket is the unit.

42. *Q*. All the tank irrigation is done by lifting?—Yes.

43. *Q*. (*Mr. Muir-Mackenzie.*)—You said that if a canal were brought into the district, all the capital expended on the wells would be lost. Why? The people need not use the cannal?—They would have to pay for it.

44. *Q*. Not unless they use the water?—If they did not use the water, they would be subject to much more inconvenience by the irrigation people to force them to use the water. One man might use the water and another might not. It would be very easy to have disputes as to whether the other man actually used it or not.

45. *Q*. But his using the well, which would be evident, should save him?—That would not always save him.

46. *Q*. You mean to say that there would be false cases?—Yes, a very fine opportunity for people to start false cases for the ordinary revenue people, the police, the zamindars.

47. *Q*. Admitting that that is a great evil, still would it be such as to make the people all give up the wells on which so much capital has been spent?—It would depend on whether the water-level would be changed or the country water-logged.

48. *Q*. The rice crops did suffer in the famine year very much?—Not the *kuari* crop. The *jarhan* crop did suffer; in fact, it was a total failure.

49. *Q*. If you had had a canal in the district, could you have saved that crop?—Yes, wherever the canal water went the crops would necessarily have been saved.

50. *Q*. At any rate, might we take it that the loss of that crop led to the necessity of relief in the district?—Yes, I should say it was owing to the loss of the *kharif* crops and dear grain.

51. *Q*. Now, if Government is to advance money for wells, it is bound to do so largely to the tenants?—Largely to the tenants and to the petty zamindars.

52. *Q*. How are the tenants to give security?—If you got the interest of your money from the land, I should say that is quite sufficient security. Of course you would have to find out whether the land was worth that or not.

53. *Q*. The tenant has no transferable interest in the land?—No.

54. *Q*. (*Mr. Roberts.*)—How is the Government to collect it?—The Government, instead of taking back the advance, would charge an extra rent and recover it from the tenant direct as revenue.

55. *Q*. That tenant at the end of seven years is ejected, what happens?—But you could always provide for your interest; the interest would always be a lien on the land. "An anna in the rupee" is merely a local saying; the rent does not depend on that "one anna in the rupee."

56. *Q*. You would have to collect it direct from the tenant?—Yes; or if the landlord was willing, you could collect it from the landlord like canal rates. The only drawback that there is to well irrigation is the expense of it.

57. *Q*. (*Mr. Muir-Mackenzie.*)—You do not think to save that expenditure the rayat would be glad to have a canal?—The rayat would, but the question is whether his land would suffer from it or not. The report is that the land does suffer from it.

58. *Q*. (*Mr. Rajaratna Mudaliar.*)—According to your proposal to levy a small additional rent upon the tenants' land, Government would be practically the owner of the well?—Yes.

59. *Q*. Would you then throw the responsibility of keeping a well in repair upon the Government?—I should say, if the zamindar become liable as Mr. Roberts mentioned for the extra charge, the zamindar would keep it in order. If he did not, and if it were merely the tenants, then, if you want to keep it in repair, the Government must look to it.

60. *Q*. Would it be possible for Government to do it?—I do not think it would.

61. *Q*. Does not your system then break down?—It may break down where the Government is concerned, not where the zamindar is concerned. That particular well does not secure one tenant's land; it secures the land of several tenants. If I give an advance to a man for a well and that gives him Rs. 8 increase on his rent, I get much more than that. That well does not irrigate one tenant's holdings; it irrigates several tenants' holdings, so that instead of getting 8 per cent. for my money, I may be getting 15 per cent. or 20 per cent.

62. *Q*. (*Mr. Muir-Mackenzie.*)—Do you think, as a matter of fact, if the well was a good one, that the tenant's interest in it would not be such that he would keep it in sufficiently good repair?—I certainly think so. He would be very sorry to let the well get out of order, because, if his irrigation came to grief, he would come to grief too and would not be able to pay his rent.

Mr. C. A. Silberrad,

MR. C. A. SILBERRAD, Sub-divisional Officer, Lalitpur.

(*Jhansi, 5th December 1902.*)

[*Note on Irrigation in Jhansi* (*more especially in Lalitpur*).]

I.—Details of some tanks made by zamindars with the aid of ordinary or famine *takavi* in the years 1895—1897 and 1899-1900:—

(*a*) ***Bant*** (***Balabehat***).—Besides the Public Works Department tank, there is a tank, or more correctly, large ***bandhia***, repaired by the zamindar with the aid of Rs. 441 ***takavi*** in 1895-96. This tank enables some 35 acres of rice (irrigated or not, according to season) to be grown below the tank, and gives some 40 to 50 acres of ***rabi*** in its bed. It is estimated (a good deal of the land is ***khudkasht***, and some is held by hereditary tenants, whose rents have not been enhanced) to have increased the annual value of the village by about Rs. 100.

(*b*) ***Sirsi*** (***Bansi***).—A tank here was repaired by the zamindars with the aid of Rs. 600 (¾ths recoverable famine ***takavi***). In 1309 F. 14 acres were irrigated directly from the tank, but the total (well) irrigated area in the village has increased as follows:—

1306	168 acres.	1308	153 acres.
1307	129 acres.	1309	196 acres.

(*c*) ***Menwar*** (***Bansi***).—Rs. 1,000 ***takavi*** was advanced in 1899 to the zamindars to repair a tank. Channels for irrigating from it have not yet been completed, but its influence is shown in the following figures for well irrigation:—

1306 F	148 acres.	1308 F.	160 acres.
1307 F.	134 acres.	1309 F.	177 acres.

Mr. C. A. Silberrad.

(*d*) *Nanora* (*Bansi*).—Rupees 400 was advanced in 1307 to the same zamindar as in the preceding case. Here, also, there is no *direct* irrigation, but the figures for well-irrigation are —

1306	151 acres.	1308	166 acres.
1307	184 acres.	1309	188 acres.

(*e*) *Rajwara* (*Lalitpur*).—Rupees 630 was advanced in 1307 for the repair of a tank, which has resulted in an increase of 50 acres of irrigation from the tanks.

(*f*) *Agori* (*Maraura*).—Rs. 1,000 *ordinary takavi* was advanced in 1307, the zamindar spent an additional Rs. 200 in the next year, and he tells me himself that his income from the village last year has increased by Rs. 150 in consequence of the tank.

Some cases have been of course more or less failures, generally owing to the bursting of the tanks, *i.e.*, the zamindars were not sufficiently skilled to ensure safety.

II.—I give in detail the average settlement, wet and dry rates for the various kinds of soil in each pargana of the district (in rupees per acre)—

Jhansi Proper. (*Re-settled 1892 to 1894.*)

PARGANA.	MAR.		KABAR.		PURWA.		RAKAR MOTI.		RAKAR PATHRI.	
	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.
Jhansi	6·7	5·06	5·33	3·7	3·99	2·72	3·23	1·63	2·12	·76
Man	...	3·45	4·01	2·66	3·91	1·84	3·72	1·58	2·11	·82
Garotha	...	3·88	...	2·99	...	2·11	...	1·60	...	·95
Motti	...	4·03	5·24	3·43	4·17	2·56	2·0	1·71	...	·94
Average	4·56	3·87	5·04	3·14	3·95	2·28	3·31	1·63	2·11	·81
Ratio of wet to dry rate	1·18		1·60		1·73		2·08		2·6	

Lalitpur. (*Re-settled 1896 to 1898.*)

PARGANA.	MOTI.		DUMAT.		PATHRI.	
	Wet.	Dry.	Wet	Dry.*	Wet.	Dry.†
Balabehat	...	1·50	3·44	·94	...	...
Bansi	...	2·00	4·37	1·06	3·5	·75
Lalitpur	...	1·37	3·69	1·06	3·19	·75
Talbehat	...	...	4·00	·75	2·87	·56
Banpur	...	2·00	3·62	·94	2·69	·75
Mahroni	...	1·37	3·75	1·69	2·75	·69
Maraura	...	1·75	2·56	·81	2·06	·69
Average	...	1·66	3·5	·94	2·81	·62
Ratio $\frac{\text{wet}}{\text{dry}}$	...		3·73		4·5	

* Cultivable for 5 to 6 years and then usually fallow for the same period.
† Ditto 3 to 4 ditto ditto 8 to 12 years.

To a certain extent the *moti* of Lalitpur corresponds to the *mar* and dry *kabar* of Jhansi proper; the *dumat* to wet *kabar*, *purwa* and dry *rakar moti*; *pathri* to wet *rakar moti* and *rakar pathri*.

The following table illustrates the fact that in the settlement circles containing the largest proportion of black soil this soil is very far from being the only constituent of the circle:—

Percentage (*of cultivated area*).

Circle.	Mar.	Mar and dry kabar.	Purwa, wet kabar, and dry rakar moti.	
Jhansi I	23	61	38	Jhansi proper.
„ II	11	37	45	
Man (IV–VIII)	50	81	17	
Garotha I	60	79	17	
„ II	47	77	17	
„ III	52	81	12	
„ IV	40	74	17	
Moth (whole tahsil)	23·5	71	25	

Circle.	Moti.	Dumat.	Pathri.
Lalitpur I	59	30	9
Banpur I	50	39	11
Mahroni I	53	32	4
Maraura I	53	25	12

It must be remembered that, save in Garotha, Moth, and part of Man, the black soil circles are not by any means a predominant portion of the cultivated area.

III.—*Details of the Pawa tank.* This was constructed first in 1868-69 famine, but the *bund* burst in the rains of 1869. It was reconstructed seven years later, the zamindar taking Rs. 3,000 *takavi*, and the services of a Naib Tahsildar being lent to supervise the work; the work done in 1868-69 had to be entirely removed before reconstruction. Some Rs. 800 or 900 of the total *takavi* was remitted.

The water is held up till the time for sowing *rabi*, and then let off and the bed sown. In 1309 the area so sown was 63·42 acres; the land is let on the *batai* system; *i.e.*, tenants and zamindars each take half the produce. The zamindars' half converted into cash at current rates was recorded by the *patwari* (and stated by him to me *in presence of the zamindars*) as Rs. 700 in 1309; and between Rs. 500 and Rs 600 in 1308. These figures are borne out by the settlement officer's note that at the time of his inspection the land was leased at Rs. 10 per acre.

In the settlement records of the 1860-67 settlement the land now benefited by the tank is recorded as *dumat*, and its total rental as Rs. 115. This gives an annual return of some Rs. 500 on an outlay of Rs. 3,000, or nearly 17 per cent. (the work done in 1868-69 appears to have been quite valueless).

The site is undoubtedly unusually favourable (a stream running through a gorge in a line of hills), but the above figures of profit leave a considerable margin.

The Raksa bunds.—(Information derived from the *patwari* and Diwan Udet Singh of Raksa.) Constructed in 1888 at a cost of some Rs. 9,250. The irrigated area (from wells) has increased since settlement (1892) by some 40 acres, and 14 acres are irrigated directly from one of the tanks. Four additional wells have been made, and these and 20 others in the village have now a better supply of water (water-level is said to have been raised 12 ft.), so that

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instead of beginning to fail by February (and so not being able to properly supply the ripening crop) there is always a good supply, even in famine years. Udet Singh (who owns 4 acres of Baksa) estimates the ordinary increase in annual value to the zamindars from the land at Rs. 100, with another Rs. 100 in a famine year. It would be more were not a good deal of the land benefited held by *maurusi* tenants, enhancements in Jhansi at present being practically impossible.

Udet Singh says there is a more favourable site for a series of *bandhs* on the Kapra Nadi, which, he says, would cost some Rs. 20,000, and would benefit villages as follows: Sijwaha Rs. 100; Raksa Rs. 500; Kotkhera Rs. 150; Palinda Rs. 200; Dongra Rs. 100; Pathan Rs. 50; total Rs. 1,100. I cannot say anything more of this idea from personal knowledge.

IV.—The following figures are interesting as illustrating the value of tanks. I take the red soil (pathri), Pargana Talbehat.

The settlement *rabi* area (1304) was 12,567 acres, and that is a fair average for this pargana, which is quite unaffected by *kans*, there being no black soil. In 1307 the *rabi* area was but 9,612 acres,—a fall of 23·4 per cent. in this pargana; there is practically no unirrigated *rabi* (irrigated *rabi* is 88 per cent. of the whole): this fall was almost entirely due to lack of water in wells. But in Talbehat village, which is thoroughly protected by a large tank which never goes dry, the *rabi* area only dropped from 1,023 (settlement) to 1,010 acres in 1307, while the irrigated area *increased* from 867 to 986 acres.

Pawa showed a decline of *rabi* area of but 9 per cent., and of irrigated area of 7 per cent.

Jakhora (in Bansi, but very similar to Talbehat) showed an *increase* of *rabi* area from 358 acres at settlement to 471 acres in 1307.

As regards the black soil, I am now camping in the black soil portion of the Lalitpur Sub-division, which, however, differs from the black soil of North Jhansi, Jalaun, etc., in being undulating and interspersed with much more *dumat*. Here, too, I find a very general desire for irrigation. As an example, the rumour of a weir on the Betwa at Deogarh one of the proposed storage weirs for the Betwa Canal) has spread, and I have been repeatedly asked whether a canal cannot come to this or that village which of course, the undulating character of the country would render impossible. Then I am asked if one of the smaller rivers could not be dammed, or, failing that, if a tank could not be made. I have already found several suitable sites for small tanks to supply one village *in this part of the sub-division;* in one village the zamindars have given in a written application agreeing to pay 5 per cent. on capital cost *plus* 2 per cent. for annual repairs; this is but a small tank, cost about 600, but this particular village is small; in several others (in the same tract, *i.e.*, 'black soil') zamindars have said verbally they would do so. The soil commanded by these tanks would be mainly *dumat*, but this bears out my contention that suitable sites could be found in this part of Lalitpur.

V.—I have seen the Bundelkhandi so often reproached with laziness that I would like to urge in partial excuse for him that the soil of Bundelkhand is, as a rule, such that with a good season it will give an excellent crop with little exertion, while in a bad one no amount of exertion will make much improvement. The irrigated centres in a red soil village (round the site) are, I think, as carefully cultivated as land is on an average in the Doab.

VI.—As regards *takavi*, I would like to place on record an idea that I have that the reluctance sometimes noted in taking *takavi* is greatly due to the uncertainty of the amount that will be distributed; with continuity in 3 or 4 years some Rs. 8,000 or Rs. 10,000 *takavi* for seed was easily distributed in the sub-division every *rabi*. In the first year, when the amount for distribution is short, application for a large sum of *takavi* had to be filed.

VII.—As regards rice, for the gazetteer I collected information concerning 16 different kinds grown in the sub-division; none of these were described as growing in *moti* in fact in Lalitpur, and I think it is the same in Jhansi proper; rice is practically never grown on black soil. Thus with an average of 8 per cent. of the *kharif* area of Lalitpur under rice in Talbehat Pargana, which contains *no* black soil, rice forms 16 per cent., while in Mahroni Pargana, with approximately equal areas of black soil, *pathri* and *dumat* rice is only 4 per cent. of the *kharif* area.

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1. *Q.* (*The President.*)—You have been 4 years in this district?—I came in March 1899 and have been here pretty well continuously since.

2. *Q.* Where were you before?—In Etah in the Agra Division, in Etawah, Farrukhabad and in Muttra.

3. *Q.* Is there any irrigation in Lalitpur?—There are tanks and there is some irrigation from them.

4. *Q.* Is there any record of it in the statistics?—There is a statement in the settlement records and the pargana registers, but you cannot say accurately how much is from tanks and how much from wells, as much of the irrigation really derived from tanks is done directly from wells below the *bandh* of the tank which are indirectly fed by it. Such irrigation should obviously be almost wholly credited to the tank.

5. *Q.* Was the famine of 1896-97 severe there?—Yes; I was not there for the famine.

6. *Q.* I suppose wells held out?—I believe they did; I believe the water-supply held out better than in the 1899-1900 famine.

7. *Q.* Was there severe distress in 1899-1900?—Fairly so, but not as great as in 1897.

8. *Q.* Were there relief works in both cases?—Yes.

9. *Q.* (*Mr. Muir-Mackenzie.*)—How many people were there on relief in 1899-1900?— I think the maximum was 7,000 to 8,000 on one day.

10. *Q.* (*The President.*)—The population is very scattered, I suppose?—Yes, 210,000 for 1,940 square miles in Lalitpur.

11. *Q.* And what is it in Jhansi? —400,000 for 1,600 square miles.

12. *Q.* Is there much scope for the extension of wells?—Yes, there is, but tanks are more necessary, so that the water-level may be maintained; the country is mainly divided into a series of rocky valleys underlain by impermeable rock; the water-supply of each such valley is derived solely from the rain falling within its limits, *i.e.*, there is little or no underground supply soaking through from elsewhere.

13. *Q.* The extension of tanks would, you think, better than under-ground supply?—It is almost a necessity, I think, before you can extend your wells to any extent.

14. *Q.* The chief function would be to act indirectly to keep up the spring level of the wells?—Not the chief function, but an important function. There are many places where more tanks could be made.

15. *Q.* There is no doubt about that?—No.

16. *Q.* Would these be large tanks or small ones?—They would for the most part not be more than sufficient to supply one village; I have been lately over a good many villages in the northern part of the Sub-division; there is a good site in nearly every village. I proposed that Government should construct the tanks and that the people should pay 5 per cent. on the capital cost and annual repairs; some agreed to this, but some did not.

17. *Q.* Would it not be better done by *takavi*?—I don't think they could do it. The Nathikhera tank burst the rains before last and the zamindars got *takavi* amounting to Rs. 500 to mend it; they kept it for four or five months and then said they could not manage it and returned the money. The zamindars have twice before repaired this tank.

18. *Q.* I suppose there is a District Engineer for the works?—There is in Jhansi.

19. *Q.* Could a subordinate be trusted with that kind of thing?—I should hardly say so.

20. *Q.* The Irrigation Department seems rather heavy machinery for that if it can be done otherwise?—Perhaps so, but you want some one who is a specialist on tanks.

21. *Q.* Would you like to see a system such as you describe carried out by the Public Works Department?—There should be a proper survey and inspection of these sites in consultation with the zamindars concerned to determine whether they would pay. If there was an officer of the Irrigation Department in charge of all tanks, they would be maintained regularly.

22. *Q.* Would there be any revenue difficulties about the zamindars paying 5 per cent. of the cost?—Some say they would do it; others say that the advantages are not sufficient. Irrigated rent is 3½ times that of unirrigated.

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23. *Q.* Would there be difficulties made about the land sumberged by such tanks ?—No, if the scheme I had thought of were adopted. Government would allow the zamindars to use the tank just as they please, provided they did not damage it.

24. *Q.* (***Mr. Muir-Mackenzie.***)—You have concluded a certain agreement ?—No; I was proposing that tanks should be constructed and maintained by Government; the zamindars should pay 5 per cent. on the capital cost, *plus* the annual cost of repairs, and that zamindars should be allowed to use the water as they please, provided they did not do any damage to the tank.

25. *Q.* (***Sir Thomas Higham.***)—Have you any idea of the expenditure necessary to protect this particular area ?—These tanks would be small ones and not more than sufficient to command part of the land of one village; they would cost from Rs. 500 to Rs. 3,000.

26. *Q.* Hamirpur has 2 or 3 acres for every million cubic feet; that seems quite as much as you could do. Where would the 5 per cent. come from ?—From the increased rent of irrigated land as compared with the same land unirrigated, thus the average Settlement Officer's circle rate for wet *dumat* is 3¾ times the dry rate; for wet *pathri* 4½ times. Moreover, quite half the advantage is from wells below the *bundh*.

27. *Q.* That is why you cannot put a water-rate on it ?—Yes.

28. *Q.* If the people could pay 5 per cent. on the capital cost and the cost of maintenance, then these would be productive works ?—A tank at Parwa cost Rs. 3,000 and the zamindars estimate that the benefit from it is Rs. 500 to Rs. 700 a year.

29. *Q.* (***The President.***)—Who made it ?—This tank was originally constructed in the 1868-69 famine. It burst in the rains of 1869; and was reconstructed 7 years later; the zamindars taking Rs. 3.000 *takavi*, of which some Rs. 800 or Rs. 900 was finally remitted. The work done in 1868-69 was of no assistance, the whole having had to be done over again. The water is held up till the time of sowing *rabi*, and then let off and the bed sown.

30. *Q.* (***Mr. Muir-Mackenzie.***)—How do you know that it costs Rs. 3,000 ?—I have been told so.

31. *Q.* (***Sir Thomas Higham.***)—Such tanks are very like field embankments ?—They let the water out at the beginning of the cold weather and sow their wheat.

32. *Q.* (***The President.***)—What would you advocate for Lalitpur as the best means of enabling it to resist famine ? —I would have a careful survey made of these tanks and of the different sites in consultation with the zamindars of the village so as to ascertain whether it would suit them to have a tank, and these projects should be carried out as funds might be available.

33. *Q.* Do you think storage of water on a large scale would assist Lalitpur ?—It might keep up the water-level, and you might take small canals out of such reservoirs, but the country is too hilly for a large canal to be possible.

34. *Q.* Have you thought of large storage works in that district for irrigation ?—Yes.

35. *Q.* Do you think there are possibilities there ? — It looks as if it should be possible.

36. *Q.* The red soil of Lalitpur is poor soil ?—Yes, the Settlement Officer's average rate for cultivated dry *pathri* is 11 annas per acre; but such soil is usually cultivated for only 2 or 3 years, and then lies fallow for 8 to 12.

37. *Q.* Is it the same as that which is irrigated ?—Yes, I believe it is; by long cultivation and manuring the irrigated land has become better soil than it was before.

38. *Q.* Do the tanks silt up much ?—I don't think they do; certainly some of the Chandel tanks have to some extent silted up, but they are probably 800 to 900 years old.

39. *Q.* Do the people look after the existing tanks themselves ?—Yes, so far as they are looked after at all.

40. *Q.* Do they do repairs ?—Sometimes, not always.

41. *Q.* Are there masonry sluices ?—In some; a good many have natural escapes.

42. *Q.* Do they irrigate *kabar* land at all ?—In Bant they do; it is called *moti* and includes *mar* and *kabar*.

43. *Q.* What is the reason why that village does it and not others ?—The tank is well situated; it was built in the 1869 famine; it burst in the rains of that year, and was repaired about 1890. Irrigation from it only began in 1899, but before that it had done much to raise the spring level and keep land near it moist and so capable of bearing spring as well as autumn crops.

44. *Q.* Do you consider it the duty of Government to repair the tanks ?—Yes, where there is a prospect of advantage commensurate with the outlay.

45. *Q.* (***Sir Thomas Higham.***)—As regards these tanks that you propose, have you any idea of the cost ?—Some have been roughly estimated as civil famine relief works.

46. *Q.* Have you got a number of these tanks in the programme ?—Yes, but those in the list are generally not the right ones. The list was made out by the Tahsildar based on Kanungo's report. I am going through the proposals, inspecting the localities and writing notes.

47. *Q.* Has it been examined by any of the Public Works Department officers ?—No.

48. *Q.* (***The President.***)—Your remarks about tanks in Lalitpur would apply equally well to the other parts of the Jhansi District ?—In the flat land it would not apply, but it would to the southern portions of parganas Jhansi and Mar,

49. *Q.* (***Sir Thomas Higham.***)—I suppose you made some tanks in the last famine ?- No, they only deepened two or three.

50. *Q.* You cannot say what was the result ?—No.

51. *Q.* Instead of 5 per cent., if you could get half that, I think there would be a very good case for the money ?—I think they would pay 2½ per cent. certainly.

52. *Q.* I suppose tanks very often burst ?—Yes, very often.

53. *Q.* That is because there is no escape ?—Yes, sometimes, but often through neglect of the *bundh* which bursts where it has been allowed to become weak.

54. *Q.* The escape generally costs as much as the *bundh* ? — In a good many places you can get a natural escape over rock.

55. *Q.* Is this programme complete ?—No, that is what I have been able to do this season.

56. *Q.* What did they spend on the Raksa *bundhs* ?—Rs. 9,337.

57. *Q.* If you wanted 5 per cent., it would be about Rs. 600; nobody could get that out of them; could they ?—I don't know what has happened by increase of revenue in the last settlement of 1892. I will try to find out and send it in.

58. *Q.* I think, if you could be sure of getting your 5 per cent. at the next settlement, it would be good enough ? —I think it could be done if the tanks were chosen properly

59. *Q.* How many works of this kind have you got (pointing to programme) ?—There are several hundred tanks and *bandhias;* by tanks I mean *bundhs* put across the drainage lines.

60. *Q.* What do you propose about the *bandhias;* should these be done by Government ?—Yes, I think this would be best; somewhat as suggested in Mr. Barlow's report.

61. *Q.* Would the people do it themselves ?—They do sometimes.

62. *Q.* Would you confine Government work to the making of tanks ?—No. In Lalitpur even in those settlement circles containing most black soil, this soil rarely amounts to more than half the cultivated area. I think in a great many places sites could be found for tanks whence the people would irrigate *dumat*, that is a mixture of red and black soil.

63. *Q.* Do they irrigate where there is black soil ?—No.

64. *Q.* If you put your tank where there is black soil, they won't use the water; will they ?—A big zamindar in Lalitpur said they would very probably use the water to irrigate black soil, but for the first watering only.

65. *Q.* Would they lift it ?—No.

66. *Q.* (***Mr. Muir-Mackenzie.***)--There are already great many wells in Lalitpur ?—In red soil in the valleys.

67. *Q.* Not under tanks ?—Yes.

68. *Q.* Do wells not protected by tanks hold out as well as others ?—Not as well; in the 1899-1900 famine in Talbehat in the red soil the *rabi* area was only 75 per cent. of the normal; the *rabi* there is all irrigated by wells or tanks.

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69. *Q.* Were the tanks useful in the famine?—The villages that suffered most were certainly those that have not got tanks.

70. *Q.* Now looking at some figures I have, I should like to ask, why more relief was not given in 1899-1900?—We were perhaps not very liberal.

71. *Q.* If relief had been given with greater liberality perhaps you could have relieved more?—Yes, but I do not wish to be thought to imply that relief in 1899-1900 was not liberal enough,—rather that it was over-liberal in 1896-97.

72. *Q.* Why was it less?—1895-96 was a famine year in Bundelkhand; in 1893-94 and 1894-95 rust destroyed the whole of the wheat crops; 1890-91 and 1891-92 were bad years. For more complete details, see Mr. Hoare's Settlement Report for Lalitpur, p. 5.

73. *Q.* They had not been able to recover completely?—No; they had had only one good year (*i.e.*, 1897-98).

74. *Q.* That was sufficient to account for the distress not being quite so severe in 1899-1900?—Yes.

75. *Q.* What are the wells like; are they most of them sunk through rock?—They go down to the rock.

76. *Q.* Do they stop at the rock?—They sometimes blast the rock, but they never go through the rock, I think; sometimes they come on to a spring, where the rock is fissured.

77. *Q.* How are the wells built?—Generally with dry bricks.

78. *Q.* They don't use stone?—In the south they use sandstone.

79. *Q.* Do they last an indefinite time?—Fifty years.

80. *Q.* And then they fall in?—Yes, if they are not looked after.

81. *Q.* If they were looked after, would they last an indefinite period?—I think so.

82. *Q.* Have you seen any very old wells?—There are a good many fairly old wells; there is a properly built well in Lalitpur which is dated 1600.

83. *Q.* Is it very expensive?—Yes.

84. *Q.* The main use of tanks would be to feed wells. Is there any difficulty about getting wells made; supposing you made tanks, would the people make wells?—Yes, they might want *takavi.*

85. *Q.* To whom would it be given,—zamindars or tenants?—Sometimes to the one, sometimes to the other.

86. *Q.* Are they small zamindars?—The majority are small.

87. *Q.* Is there any difficulty in getting a joint agreement for *takavi* for a well or tank?—There is sometimes difficulty, but you could square them if you talk to them.

88 *Q.* Would these tanks hold out in a year like 1896-97?—Yes, they had 35 inches against an average of 40.

89. *Q.* And in 1899-1900?—They got very dry that year.*

90. *Q.* But wells nevertheless held out?—The *rabi* area went down 23 per cent.

91. *Q.* As regards this tank that cost Rs. 3,000, do you know what area is actually irrigated?—It is more in the nature of a *bandhia.*

92. *Q.* What is the area inside the tank that grows a good crop?—60 to 70 acres.

93. *Q.* And the rental of that land?—The land is now leased on *batai*, *i.e.*, the tenant and zamindar each takes half the produce; in 1301 F. the zamindars' half converted into cash at current rates was recorded as Rs. 700; in 1308 between Rs. 500 and Rs. 600. At settlement the land was leased at Rs. 10 per acre.

94. *Q.* What is the dry rate?—The land benefited by this tank was recorded in the 1860-68 settlement as *dumat* and the total rental of the area as Rs. 115.

95. *Q.* (*Mr. Rajaratna Mudaliar.*)—Does the whole of the rent go to the zamindar?—Yes, Government has nothing but the land revenue.

96. *Q.* (*Mr. Muir-Mackenzie.*)—Do you think most of these tanks that you propose to make would have an area inside them that would be cultivable?—Some would; some would not; it depends on the situation.

97. *Q.* Do you propose most of these tanks as relief works?—Yes, but they would, of course, want some masonry.

98. *Q.* Did you propose them as relief works in 1899-1900?—Yes.

99. *Q.* Were they adopted?—To some extent, the famine besides was not so great as was expected; there was some hesitation about putting the workers on tanks.

100. *Q.* Why was there hesitation?—The projects were not quite ready.

101. *Q.* You don't think there would have been hesitation if the projects had been ready?—I think the engineers preferred roads as being easier to manage; these tanks are comparatively small works and more difficult to manage.

102. *Q.* With regard to the difficulties of management you don't consider them insuperable?—No; I am speaking, however, without much famine experience. I don't see why four to five tanks in neighbouring villages should not be made into one charge.

103. *Q.* You have spoken about the large rent a zamindar may expect if he makes a useful tank; why is it then that, with exemption from assessment, the zamindars have not done more than they have?—They have not the money, and they are not a particularly energetic lot; some of the bigger zamindars have done something.

104. *Q.* What has been the results?—I have no figures, but I will send them in.

105. *Q.* Was there much contraction of cultivation as the result of the famine of 1896-97?—Not very much; there was a considerable change in the crops sown, but that was not so much due to famine as to rust.†

106. *Q.* There are a large number of these tanks still existing. Are they in very bad repair?—Some are in excellent repair, but some have been let go.

107. *Q.* You recommend in your note that Rs. 50,000 per annum should be spent on construction and repair of tanks; do you think any money should be spent on the repair of existing tanks?—Yes, I think so.

108. *Q.* (*The President.*)—Do you think it is the duty of Government to keep them in repair where the people pay wet-rates?—Yes.

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* Rainfall at Talbehat for period June to May—

1895-96 – 24 23 inches.
1896-97 – 37·88 „
1899-1900—19 63 „

Average for 23 years—36·28 inches.

Average rainfall at the four reporting stations in the sub-division for same periods;—

1895-96 – 29·35 inches.
1896-97 – 37·08 „
1899-1900—26·05 „

† The following figures illustrate this change :—

	Kharif.				Rabi.			
	Total area.	Small millets.	Juar.	Tili.	Total area.	Wheat (alone).	Wheat in combination.	Gram.
Average—	Acre.	Acre.	Acre.	Acre.	Acre.	Acre.	Acre.	Acre.
1298—1302 .	210,421	104,360	34,803	34,109	104,457	57,811	12,560	24,874
1306 . .	253,067	107,433	60,416	43,058	55,221	12,887	12,570	18,158

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109. *Q.* (*Mr. Rajaratna Mudaliar.*)—As regards the Pawa tank, were the lands in the water-spread uncultivated before the tank was repaired?—I believe they were cultivated like other dry lands.

110. *Q.* If a tank was repaired by Government at a large outlay, could the zamindar come in and levy a wet-rate?—Yes.

111. *Q.* Is that allowable under the law?—I don't know if it is allowable; in Lalitpur they hardly know what occupancy rights are.

112. *Q.* (*Mr. Muir-Mackenzie.*)—Would the landlord have any difficulty in getting another tenant for a good bit of wet land?—No, if he takes too much they leave him.

113. *Q.* (*Mr. Roberts.*)—Lalitpur is a particularly backward district; is it not?—Yes.

114. *Q.* The cultivated area compared with the culturable area is comparatively small?—Yes.

115. *Q.* And what is cultivated, you explained, can only be cultivated three years out of ten?—Yes, that is outlying and in the red soil tracts.

116. *Q.* A zamindar's rights are greatly subdivided in these parts?—Yes, in a great many villages, especially among the Lodis and Kurmis, you get some comparatively big Bundela landlords.

117. *Q.* A great many villages are *pattidari*?—Yes.

118. *Q.* And they are cultivating zamindars?—Yes.

119. *Q.* In those *pattidari* villages the best lands in the village are mostly cultivated by zamindars?—Yes.

120. *Q.* These Lalitpur people are very little given to civil and rent litigation?—Yes.

121. *Q.* They are particularly amenable to authority in these matters?—Yes.

122. *Q.* And the amount of civil and rent litigation relatively to the population that gives rise to litigation is smaller than in the district?—Certainly, there were, I think, only 19 ejection cases.

123. *Q.* That points to the fact that occupancy rights are not particularly valuable?—Yes.

124. *Q.* Landlords are not exerting themselves to prevent their acquisition, nor do tenants lay any great store by them?—No, occupancy rights, except as regards land within the *tareta* of the red soil villages, have almost reduced themselves to the right to a somewhat uncertain amount of certain kinds of land at customary rates.

125. *Q.* There is no great difference between occupancy rents and non-occupancy?—Practically none; Mr. Hoare finds that, if anything, occupancy rights are a bit higher.

126. *Q.* In the case of improvements made, the question of the amount of benefit the tenant would be entitled to would be settled rather by custom than by recourse to the law courts?—Yes, certainly.

127. *Q.* The tenants would pay the same rates for wet land, however it had become wet?—Yes, they have certain customary rules to determine the amount for wet land.

128. *Q.* Neither party would claim the interposition of the law?—No.

129. *Q.* As regards these civil works that you call *bandhia* in your report?—I should have said village relief works.

130. *Q.* That means works not to be carried out by the Public Works Department?—Yes.

131. *Q.* Roads and big tanks employing 5,000 people are allotted to the Public Works Department and smaller works to the Civil Department?—Yes, but as regards the numbers in this programme, I would not like to lay any great stress on them.

132. *Q.* Would there be much difficulty in supervising these works?—I expect there would be.

133. *Q.* The principle of the division is that the works are supposed to be less open to supervision?—Yes.

134. *Q.* You mentioned one reason, why more tanks were not made is that the zamindars were too poor; that gives the hope that they would do more; you mentioned also that there are a great many existing tanks that have been allowed by the zamindars to burst and fall out of repair. What is the reason of this; can you say?—Want of money largely, but also want of energy and slackness, and also to the number of co-sharers which makes it difficult for them to arrange between themselves how to distribute the cost.

135. *Q.* If these tanks were taken up by Government on any extensive scale it would seem to follow that the repairs should be under Government supervision?—I think so certainly.

136. *Q.* They could not be left to zamindars?—I don't think so.

137. *Q.* (*The President.*)—Is there any point you would like to bring to the notice of the Commission?—I was talking lately to the *rais* of Gursarai. He wants a canal taken out of the Parichha reservoir on the east of the Betwa so as to take water into the Garotha pargana in which his estate (65 villages) lies. The difficulty here would be the hills near Parwa. I was also talking to a considerable landowner of Chirgaon who asked about the possibility of constructing a short canal from Parichha at a higher level than the existing Betwa canal to irrigate land around Chirgaon (*i.e.*, nearer the head-works of the canal).

138. *Q.* Would the *rais* be willing to take water on *mar* land?—He said he would, but it is mostly wanted for *kabar*.

MR. R. P. ATKINSON, Superintending Engineer, Public Works Department.

(*Jhansi, 5th December 1902.*)

Mr. R. P. Atkinson.

1. *Q.* (*The President.*)—You were formerly Executive Engineer on the Betwa Canal?—Yes.

2. *Q.* Had you any experience of Bundelkhand before that?—No.

3. *Q.* Were you here in the famine?—No. I know nothing about the famine in Bundelkhand.

4. *Q.* What do you think the best course for extending irrigation in Bundelkhand?—Developing the present system and building storage reservoirs.

5. *Q.* The first depends on the second?—To a great extent. But we can do more irrigation with what we have got, *i.e.* by developing the system.

6. *Q.* To a material extent?—Yes, especially in a year of drought, because at the end of the rains at the beginning of the cold weather there is always a large amount of water in the Betwa. As soon as our distributaries are made sufficiently large we can utilize a great deal of the surplus water.

7. *Q.* You have no doubt about that?—None.

8. *Q.* The figures are not very encouraging?—No; the canal has been badly handicapped for want of water.

9. *Q.* Extension depends on whether there is any more water?—I think so certainly, particularly as regards the *kharif*; that is the early *kharif*. We could double the *kharif* if we could get the water stored. All through last cold weather whilst I was marching about the canal I had to say that I could not promise water for early *kharif* sowings, as the cold weather had not developed itself; I did not know whether it was going to be a dry or a wet year. It turned out to be dry and we used all the water for the *rabi*.

10. *Q.* That is the water stored?—Yes. We include also the water which is running down the river all the time.

11. *Q.* In the hot weather what does that amount to?—Nothing.

12. *Q.* Then you would have to be living on your method of storing water?—We are living on it now. We always try when the demand is hot to run down as much water as we can; it is generally more economical, and that very soon becomes more than the river can give us. The demand is increasing; the river supply is decreasing.

13. *Q.* (*Mr. Muir-Mackenzie.*)—Do not you get full up in January or February?—Two years ago we more than filled up; we could have filled up three times over; that was an exceptionally wet year. The river and the canal just balanced this year at the beginning of November. The water could be seen running over the shutters for some days afterwards as a freshet came down.

14. *Q.* What state are the Ken and Dassan projects now in?—I am afraid I cannot tell you very much about them. They are not in my charge. They are directly under the Chief Engineer. The Ken Canal project has gone up for the sanction of the Government of India. I do not know what state the Dassan project is in.

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15. *Q.* Can you tell about the Pahuj? Is there any water in that?—Practically nothing.

16. *Q.* There is the Burwa?—It is a very small stream.

17. *Q.* I understand that the basin of the Betwa is a very large one; the rainfall is a very fair one; the soil, hard rock, would enable you to store a great deal of water; and I suppose that really a very small portion is stored?—I think about one-tenth of one per cent. if so much.

18. *Q.* We heard yesterday that where there are these storage tanks they practically do their own catchment business; there would be no object in making them bigger?—What we call the lakes, yes. The Barwa Sagar and the Bela Tal are always full, and they would probably bear a little increasing but the others are rather bigger than their catchment, already.

19. *Q.* In your letter of 18th September 1901 you say that you have inspected several sites?—There were two methods of storing water suggested; and I was told to investigate the question. My conclusion was that the only practical one was a dam across the river Betwa. The other alternative was the finding of suitable sites for large reservoirs in side valleys.

20. *Q.* Have you made an investigation of this great basin?—No, only a little of it with Mr. Silberrad. There is an enormous basin and a great deal of it is in Gwalior and the Central Provinces.

21. *Q.* There should be no difficulty about making it?—No. It was impossible at that time to do anything beyond making a preliminary inquiry; I had not time for anything else.

22. *Q.* Do you think that the four sites in side valleys inspected by you are really favourable?—Not for very large storage.

23. *Q.* As large as above Parichcha?—No, I do not suppose that the whole lot would be a hundredth part of it. Parichcha is an enormous reservoir, 12 to 14 miles long, with 2,750,000,000 of cubic feet of available water. We want about twice that at least.

24. *Q.* With respect to the Betwa; you inspected sites with a view to damming it?—Yes, I saw two sites. One is the lowest down the river of the proposed dams. I think it is about 40 to 50 miles above Parichcha; and the other is the one which I think is the most promising, but it is the furthest away and is situated on the borders of the Central Provinces on the main river.

25. *Q.* Have you any idea how much the storage would be?—I think the figure is nearly a thousand millions.

26. *Q.* What is the limit in a case like that? Is it that you would spoil valuable land?—No, the limit is the cost. It is cheaper to make two dams than to make one big one, because of the enormous increase in the section of the dam as you get down. At the upper site you could make a dam 100 feet high or more.

27. *Q.* You think then that you could largely increase the irrigation from your canal if you had the water to do it?—I am certain, when the improvement of distributaries has been completed. An instance is what I mentioned just now. We lost the whole of the *kharif* that we might have had this year; we had not water enough; we had used it all for the *rabi*. As a matter of fact, a few hundred acres of *kharif* had been done with *paleo*. But if we had had the water, instead of this being a few hundred, it would have been a few thousand acres carried to maturity. As the water-supply failed, we had to remit the water-rate on the *paleo*.

28. *Q.* (*Mr. Muir-Mackenzie.*)—What is the meaning of *paleo*?—Water sent on to the ground to enable them to plough. After the rains it is generally done with the rains moisture.

29. *Q.* Have you establishment enough to work out the design of one of these big tanks?—Not enough to do it as quickly as I should like. I cannot spare the establishment at all now that the irrigation has begun.

30. *Q.* Any chance of getting adequate men from outside?—Yes, plenty of men if I had the money. A survey was done to a certain extent by Mr. Thornhill in 1882, and we simply want to verify this and get a few additional levels and sections and it would not take a month to get the scheme out.

31. *Q.* (*The President.*)—Could you lay your hand on 10 surveyors?—Yes. The real difficulty would be the supervision; it is a question of money. We have not the establishment in the Department at present.

32. *Q.* It is a matter of a few hundred rupees?—And the matter of getting the men. I can get the men to do the actual survey work.

33. *Q.* (*Sir Thomas Higham.*)—Have you any estimate of the cost?—We have one estimate taken out completely for one reservoir dam and we have the rough estimates for the whole six, but the rough estimates were made several years ago and they are insufficient.

34. *Q.* You have only seen two sites?—Yes.

35. *Q.* Have these been estimated for?—One of these has been estimated for (map).

36. *Q.* What do you submerge in the latter?—All jungle. A bit of Gwalior territory will be the only trouble about it. That will be 6 or 7 hundred millions.

37. *Q.* How much do you want?—Double what we have—an additional 3,000,000,000.

38. *Q.* What will that do?—It will secure *rabi* in a dry year and also *kharif.*

39. *Q.* The *kharif* at the end of a dry year?—That would depend entirely on the river. In a year like 1899 it would not secure early *kharif*; in a year like 1896 it would.

40. *Q.* That is to say, if the water is not wanted for the *rabi*?—The *rabi* will be generally done from the river supply.

41. *Q.* But whatever you could do with storing water it would not bring you much in from a revenue point of view. Would you not be able to do more than three or four thousand acres?—Not much more.

42. *Q.* Is it worth while making the reservoir for that?—I think so; for that and the other advantages of the additional irrigation in a dry year.

43. *Q.* What is the one estimated for going to cost?—7 lakhs.

44. *Q.* (*The President.*)—It would not be very profitable if you had that storage to use it for the *rabi*.

45. *Q.* (*Sir Thomas Higham.*)—If the rain came down for the *rabi*, it would be used for the *kharif*?—With a downfall of rain in the *rabi* we should fill our reservoirs again and use the water for *kharif.* It would not often occur.

46. *Q.* You fill any hiatus in sowing? If you could double the amount of water, you would use it all in the *rabi*?—Yes.

47. *Q.* (*Mr. Muir-Mackenzie.*)—In a year of good rainfall?—No, in a year like the present. This is an average year, rather against the canal and for the cultivator, if anything. But it all depends on the cold-weather rain. If there is none this year as last, we shall use every drop we have by the end of the *rabi*. If there is good rain, we shall be left with a reservoir full no doubt. It all depends on two inches of rain in the cold weather.

48. *Q.* Why you want to develop the *kharif* is because you have a standing supply in your reservoirs?—And to improve the country generally.

49. *Q.* (*Sir Thomas Higham.*)—You say your 900,000,000 would cost you 7 lakhs to store?—About.

50. *Q.* If you have four times that quantity?—The others will be much cheaper; the sites are better.

51. *Q.* This is a prohibitive rate?—It is not the reservoir I advocate to be the first to be made. We shall have an estimate for a very much better one as soon as we can spare time to make it out. We have rough surveys; we simply have to develop them.

52. *Q.* What extra irrigation do you expect to get from *rabi* irrigation?—It may be either in *rabi* or *kharif.* It will depend on the season.

53. *Q.* What will the storage give?—I think it is about 40,000 to 50,000 acres *rabi* and 4,000 or 5,000 *kharif*. There is not a very strong demand at present in an average year; it would all be worked up gradually.

54. *Q.* You say here that the cost roughly estimated is 15 to 16 lakhs. What is that the cost of?—The 3,000,000,000 cubic feet of water.

55. *Q.* Do you think it would come to that?—I think it is a very liberal estimate.

56. *Q.* It does not appear a liberal one from this?—Yes, the figure should have been 9 hundred millions, not 7.

57. *Q.* The one higher up would be very much larger?—Yes. There is a large natural store of water below the rock, and by tapping that we should get at least 200,000,000 more.

58. *Q.* Are any of these on tributary streams?—All are on the main river.

59. *Q.* You cannot depend on these others?—They are not so certain as the main river, but two of them are very

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fair catchments. However, the estimated volume of storage is very small on them.

60. *Q.* I understand that you only charge 8 annas an acre for the irrigation of *mar* and *kabar* that goes on in September?—The charge is 8 annas. All crops that take one watering are charged Re. 1 flow and 8 annas lift.

61. *Q.* That is any soil?—Yes, except *mar* and *kabar*.

62. *Q.* And *mar* and *kabar* are only half that?—Yes.

63. *Q.* I asked because I infer from this statement of yours, on page 32, that you considered an increase in the *mar* and *kabar* areas in 1896—a steadily maintained increase. But I now understand, which I did not when Mr. Laurie was here yesterday, that the increase has been due to the lowering of the rate?—No doubt that has had some influence, but the increase is also very much due to the fact that they have found out that irrigation is very beneficial. In *kabar* they have always irrigated fairly well.

64. *Q.* (*The President.*)—It would depend when this change was made?—In 1896-97. In 1897-98 the area was 7,000; in 1898-99, 12,000; in 1899-1900, 10,000; in 1900-01, 10,000; in 1901-02, 15,000.

65. *Q.* (*Sir Thomas Higham.*)—That has been obtained by reducing the rate?—To some extent. I think both influences have been at work. They find that black soil will take irrigation.

66. *Q.* You think that in good years irrigation does not increase the value of the crops at all on the Betwa Canal?—As regards *mar* soil it does not.

67. *Q.* And the other?—In the *purwa* it certainly does. The latter is practically the same as the Doab soil.

68. *Q.* Even if you had good rain the *purwa* soil is benefited by irrigation?—Very little then; but that only occurs once in 15 years.

69. *Q.* Have you anything to say on the question of the financial failure of the Betwa Canals?—I think the main reason is that the cultivators are not yet used to the canal, and that they are a very slack lot and will not take anything of the kind till they are taught.

70. *Q.* If they will not have rice you could run water on to their *jowar* in September?—We could in a dry year.

71. *Q.* Would it ever affect materially the financial position of the canal?—Most certainly. If we could get rice introduced, it would very much affect the financial condition of the canal.

72. *Q.* Is it necessary to have an early *kharif* supply to get a rice crop?—That is the trouble. Most kinds of rice can be grown after the rain has broken, but none about here that I know of. There is a good deal of rice near Jhansi. For three years running the rice below a tank which I know was an absolute failure, because the rains broke so late. The intention of that tank is to irrigate rice below in the rains and then to run the water off and cultivate the bed of the tank.

73. *Q.* Is it broadcast rice?—I have never seen it planted. From the look of it it is broadcast.

74. *Q.* (*Mr. Muir-Mackenzie.*)—I see from your rainfall statistics that there has been very good rain in June on the canal in 8 years out of 10?—In the last three years since I have known the Betwa Canal, there has been no rain till the middle of July.

75. *Q.* I mean 1891-92 to 1900-01. There are only two where the rain has broken in July. In most Junes it has been over 7 inches; once over 9 inches?—In 1900 there was no rain worth mentioning.

76. *Q.* That is in Jalaun. I do not know whether it will refer to Jhansi?—Not necessarily.

77. *Q.* (*Sir Thomas Higham.*)—July is the sowing time for rice?—That is the time for transplanting it.

78. *Q.* Broadcast rice?—Yes, they sow broadcast rice in Dehra Dun as soon as the rains are down.

79. *Q.* You think they would do that?—They will have to be taught; they are not accustomed to it and are a slack lot.

80. *Q.* They have had a good many years to learn it in?—There has been so often the difficulty of the water-supply in the canal.

81. *Q.* You can always have plenty of water as soon as the rain falls. You do not open the canal then?—We have had nothing to open it for so far.

82. *Q.* The rice is waiting for the water and the water is waiting for the rice?—I do not think that the rice is waiting for the water. Cultivators have made no arrangements for sowing rice. Nor will they do so until they are taught.

83. *Q.* (*Mr. Muir-Mackenzie.*)—With this rainfall in July, if the cultivators wanted to sow rice at all, would not they have had enough rain without the help of the canal? The average of July is 8½ inches?—It would be enough if they cared to do it.

84. *Q.* I do not see that the canal is responsible for their not having rice?—If rice is to be introduced, we shall have to teach them rice. I have spoken to them about it and they say that they do not understand rice. If we could find some rice that would grow when sown in July, the canal would develop the area, especially when rain failed.

85. *Q.* I do not quite understand on what you base your hope that in a year of good rainfall you would extend your irrigation if you had this increased storage. Do you find that the people are more disposed to take water than they were?—They are certainly more disposed to take water than they used to be and increasingly so.

86. *Q.* Is that not only on account of successive bad years?—I think not. I think the new settlement now going on in Jalaun District has something to do with it.

87. *Q.* What has that to do with it?—In one or two parganas the settlement has been done and they are keen on extending cultivation and irrigation because the land has been assessed as dry and in large areas as uncultivated.

88. *Q.* Then they will have to pay wet-rates?—Yes, but less rent.

89. *Q.* We have heard that the landlords can raise rent with the greatest facility in this country?—That was Lalitpur.

90. *Q.* I thought it applied to the whole of Bundelkhand. Is not that the case in Jalaun?—I cannot say certainly, about that.

91. *Q.* I confine myself to the apprehension that, given good years, irrigation would go down. Even now in 1899, 1900 and 1901 they were pretty bad years, but you only had 32,000 acres and 30,000 against 27,000 in 1890?—In 1899 we had only 32,000 because we had no more water and we had to remit irrigation revenue on some of the land irrigated because we could not give water.

92. *Q.* In 1900-1901?—We had a tremendous lot of rain and they did the whole of the 34,000 acres by the 15th of December. Rain broke after a great part of the irrigation had been done and we were left with our reservoir full at the end of March.

93. *Q.* Did you manage to start the *kharif* in 1901-02?—Yes. But they had had none the year before on account of exhausted reservoir, and they had got disheartened. The area was about 2,000 acres. For this *kharif* just past (1902) it was the same as before when there was no water.

94. *Q.* If you had had this extra storage in 1896-97, would you have irrigated double the area in the *rabi*?—I do not think that we could very well have disposed of the water as the canal then stood. No improvements had been made then and the channels were all contracted. With the improvements finished which are now in hand we could certainly have done it. You may notice that the area of last year 1901-02 was 48,000 and the area in 1896-97 was 62,000. Last cold weather was by no means a famine year; it was a dry year. We began irrigating much later than in 1896-97 and we had 48,000 acres against 62,000 in a year in which every drop of water was made the utmost of.

95. *Q.* In improving the channels are you doing anything in the direction of taking more water on to better classes of soil—the *kabar* and *purwa*?—No, we are not doing anything in that direction. We are allowing the water to go where it will be taken. At present the Betwa Canal requires general encouragement more than anything else.

96. *Q.* Is it not possible to carry the Betwa water to a larger extent into better soils?—No. There are only small extensions of present channels possible, running them a little further on. There are very few new tracts of the better soils we can go into; practically none.

97. *Q.* In these days when you have very little water what is the system? Does the cultivator help himself to the water when he wants it?—The system is the same throughout these provinces. You have the distributaries running down the country and the distributaries have the outlets and from the outlets the village channels are carried about over the fields. When the water is passed down the distributary the cultivator takes the water when he wants

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it. We feel the pulse of the demand and let the water through the distributaries according to that.

98. *Q.* You do not find, with this system of everybody taking the water when he wants it, without warning you beforehand, that it leads to your being short of water later on for a second watering?—No. Of course we have to watch. We know pretty well how many waterings a field can do with, and if there is any risk of running short of water, we should issue notice and put on periodical closures, not so as to stint them in any way, but to prevent any risk of waste.

99. *Q.* You did mention that you had to remit because you had not been able to give water?—That was because our channels were in a tight state; we could not get the water down and we wasted a good deal in shoving it along. Now we can run it down in large volumes and satisfy everyone simultaneously.

100. *Q.* You are satisfied that under this system you can so feel the pulse of the demand that you run very little risk of stinting anyone?—I think so. That is my experience. Mr. Laurie, now on the Betwa Canal, is having exactly the same experience now (middle of January) and is doing very well.

101. *Q.* We have been told in Bombay that you must have an application beforehand for water in order that the Canal Department may be fully aware of the drain likely to be made upon it?—I suppose that is where the supply is very limited indeed. It is not necessary here.

102. *Q.* But your own supply is limited?—Yes, but we can always reckon on enough to see the *rabi* through. Sowings are only effected in a certain period; that of course we are bound to see through. In a year of big demand there is much done in the fields sown with rains moisture. If they can get water on to that, it is all the better for them and for us, but we have no responsibility there. The whole system is divided into reaches of a few miles with a patrol in charge and he reports every two or three days thereon to the zilladar who is the Revenue Officer; he keeps the Executive Engineer informed.

103. *Q.* Have you any opinion regarding this scheme for making a number of small tanks mentioned by Mr. Silberrad?—I have seen a little of Lalitpur, and I think the scheme would be of very great benefit.

104. *Q.* Could they be made to give any return—not necessarily a full one?—Some, but most of them could not. They would all do good of course.

105. *Q.* Could the Irrigation Department take the work up?—Within limits I think they ought to take it up.

106. *Q.* Wherever the tank irrigates 100 acres for instance?—I think so.

Mr. F. J. Norman.

MR. F. J. NORMAN, Calcutta.

(Agra, 15th December 1902.)

1. *Q.* (*The President.*)—You have sent us your report and we will be glad to hear more about the system you have got, what it costs etc.?—I have put all that in the report. The ordinary irrigation well as used in Japan is about 300 feet deep; that is with this Kazusa system. Where too many of these 300 feet wells are together, the Japanese put wells down to the 480 feet strata, and very seldom to the 720 feet strata; but 300 feet is about the average depth of irrigation wells in the Kazusa valley.

2. *Q.* What is the soil?—It consists of sand, clay, decomposed granite, and occasionally layers of pebbles.

3. *Q.* And the spring level is not reached until you get down to that?—The first spring is at 300 feet. Of course this is not all over Japan; it is only where Kazusa wells are sunk. After my report was written and had been discussed in the Japanese newspapers, a paper manufacturer in the suburbs of Tokyio came to me and asked me about this system, and he put a bore down to 800 feet before striking water.

4. *Q.* What is this valley like?—There is a high range of hills lying back of it, 12 to 20 miles from the sea, and then and along Tokyio Bay the land has been reclaimed for two miles out seawards. Kazusa style wells are even sunk in this reclaimed land which about four years ago was sea. The highest point in these hills is Mount Tsukuba, which is 2,925 feet high.

5. *Q.* Is there anything different about the place to the country in general?—All around Chiba the country is more undulating than hilly, while in other parts of Japan the land is more hilly than undulating.

6. *Q.* Then the Kazusa system originally came over from China?—Yes, or at any rate a system very much like it. Abbi Hue's book on China gives a short account of the Sychuan system. In my report I say that trial borings have been made up to 1,200 feet, but since that report was written, 1,400 feet were bored in another province, in Echigo where the oil-fields are. There the soil is disintegrated granite with solid boulders interspersed. When they struck one of these boulders it was very slow work.

7. *Q.* Is this system used then for boring for oil just as well as for boring for water?—Yes. An American Missionary, who was up in Echigo some 18 or 20 years ago and knew something about oil, told the Japanese that there was oil there. A Japanese syndicate was formed and took some of these Kazusa men to Echigo who put down trial borings for oil. In the meantime the thing was a good deal talked about and the Government then employed an American expert with American machinery, and now Echigo is a great oil-field. In fact the Standard Oil Company, under the name of the International Oil Company, has stepped in.

8. *Q.* Is this system being practised as well in China?—It is still going on there now. I have not seen it myself, but I was told that it was so the other day by a man in the China customs, and also by an American Missionary.

9. *Q.* In the Kazusa valley are there special surroundings there which differentiate it from the country in general?—I should not think so. They have tried the Kazusa system in Tokyio which is 22 miles away and struck water.

10. *Q.* I suppose there is some irrigation in Japan?—A very great deal.

11. *Q.* Have you seen irrigation wells of this description?—Hundreds of them, all round Chiba.

12. *Q.* Is there a considerable area commanded or watered by these wells?—I have no idea what area is watered by such wells, but it is something considerable—hundreds of thousands of acres. I tried to get statistics from the Japanese authorities, but failed. In my report I say from two to five acres. That is a very big area for one well; I should have put it down at from 1½ acres to three acres per well.

13. *Q.* You have been some little time in India and have seen the style of country we have around us here. Do you consider that is the sort of country where this system could fairly be tried?—I see from the geological report here of a well having been put down in Agra and that the water came up within 20 to 30 feet of the surface. I don't see why that very costly well that was put down here by European methods could not have been put down by the Kazusa system. I would not like to say how much cheaper the Kazusa method would be, but I know that Burn & Co. of Howrah would turn out the whole plant required for Rs. 200 to Rs. 300, while the plant that sunk the well here must have cost landed in Calcutta £800 at the very least. Besides that you have had to pay for the enormous costly piping, while the Japanese use bamboo piping. Since I have been here I have had long talks with Major Prain, Superintendent of the Botanical Gardens at Sibpur, and have been comparing the bamboos of this country with those of Japan and I have found this bamboo (shown) which is an Indian bamboo is similar to the Japanese one, which is 2½, 3, and up to 4 inches internal diameter. This is a very fine bamboo and you get it in any quantity in Sylhet and Assam. There is one thing, however, I must tell you, and that is that bamboos are cultivated in Japan, whereas the Indian bamboos are allowed to grow wild in the jungles. When I was in Calcutta, I went down to Balliaghatta which I was given to understand was the great mart for bamboos, and there I picked this one (shown) out of a large number, and it reminds me in every way of the Japanese bamboo.

14. *Q.* (*Sir Thomas Higham.*)—What will the inside diameter of this work out to?—2½ inches.

15. *Q.* You say these wells are sunk in only one particular province in Japan?—That is so at present. It has not been known elsewhere. It was by a mere fluke that I found out this system. I had been over the district time after time snipe-shooting, and I must have passed such wells hundreds of times, but I never took any notice of them till about two yeas ago when I went down and lived near Chiba, and then I noticed them and made enquiries regarding them.

16. *Q.* Why is it they have not been used anywhere else?—Because they have not been known sufficiently. Until quite recently, within the last 25 years, the communications in Japan were very bad indeed and then the feudal system was in vogue. The different feudal lords were very jealous of each other, and if one of them got hold of a good thing like this Kazusa system, they would not allow their neighbours to know anything about it. The Japanese are a very suspicious and secretive people, and although they learn all they can from other nations, they don't like to impart any information to others. At first I could get nothing out of them about the Kazusa system, and the native whom I employed to assist me in my inquiries had a great deal of trouble with the native officials until I went to the latter and told them that if this sort of obstruction continued I would put the whole thing in the papers and bring it to the notice of the higher authorities, and then my troubles ceased.

17. *Q.* Wherever these wells are sunk you have artesian conditions?—More or less. Wherever a 720 feet stratum is struck, you will find the water rising four inches to a foot above ground.

18. *Q.* Are there not many wells where the water rises but not up to the surface?—There are, but they are generally very old wells.

19. *Q.* When a well is first made the water does rise to the surface?—Some times not, but when this happens the well-sinker uses one of the tools which I have described in my report, and which they call "the coaxer"; it is used for clearing the pipe and for pumping up the water. You see the water sometimes remains 20 or 30 feet below the surface, and they work it up higher and higher day by day until it flows over the top of the pipe.

20. *Q.* Do they never put wells down and fail to get the water?—Yes, at times they do, but not often in the Kazusa valley. I don't know what the conditions would be in order parts of Japan. I only know that in Kazusa and around Chiba these wells are to be met with in hundreds.

21. *Q.* There must be strong artesian conditions for it?—Yes.

22. *Q.* What is the diameter of these tubes which they put down?—Their bamboos are smaller than the Indian bamboo. I should say the inside diameter of their wells on an average is not more than 2 inches; 2 inches would be a fairly big well.

23. *Q.* You say they put down these wells and pay only when they find the water?—Yes. Generally, no water, no pay. That is the system they go upon.

24. *Q.* They always do find water?—Yes. These well-sinkers live in the valley and they know the district thoroughly well and can tell you whether they will find water or not in a place.

25. *Q.* How do they pay; according to the depth gone down?—300 feet wells cost from 27 yen to 30 yen, *i.e.*, from £2-14 to £3. A yen, we will say, is 2 shillings.

26. *Q.* Do they pay by the foot?—No. It is simply by the well.

27. *Q.* What do they charge for a 720 feet well?—From £8 to £10. Of course that is purely the well-sinking work; the coping and kerb go into another account.

28. *Q.* Do you suppose these men can sink wells at anything like those rates in India?—I think they would have little trouble. You would have to leave a man in Calcutta, or wherever you have your bamboos to pick your bamboo. The bamboos here are not very straight; at least very few of them grow straight here, but they might be cultivated to grow straight here as they are in Japan. I explained to Major Prain of the Botanical Gardens at Sibpur how they were cultivated in Japan, and he was of opinion that there was nothing to prevent the same thing being done here.

29. *Q.* About what length are the bamboos they put down in Japan?—The full length of the bamboos up to taper point would be about 40 to 60 feet in Japan, but each section of piping is about 12 feet; in fact they are anything from 10 to 16 feet, but 12 feet is about the average, and then they join on in this way (illustrates).

30. *Q.* Supposing you were able to get the bamboos there is no other reason why wells should cost more to sink in India than in Japan?—No. You would teach the natives how to do it. There is only one skilled man required, "the boss," who sits over the well and directs operations. He must be more than an ordinary intelligent coolie; the other men are simply coolies who do the filing and letting down of tools in the bore-hole.

Mr. F. J. Norman.

31. *Q.* There is only one man who really knows anything about it?—Yes.

32. *Q.* What does he get paid?—He takes a contract. The income of the man in Japan with whom I worked up the system is not more than 12 to 15 yen or 24 to 30 shillings a month; that is what his profits come to.

33. *Q.* (*The President.*)—I suppose labour is cheaper in Japan than it is in India?—It is cheaper in the sense that it is more intelligent labour. The *saki*, as you may know, is the national drink of the Japanese, and for the manufacture of it the purest water is required. Therefore the factories where it is manufactured, and which are situated away in the mountainous districts, have to get the water above the line of cultivation, and instead of using iron pipes to convey the water to the factories they use bamboo pipes and I have myself known of a case where water has been brought 18 miles in pipes like that.

34. *Q.* (*Mr. Roberts.*)—How do they get round the corners?—They make joints from cubes of wood (illustrates his meaning). And I have heard from the Japanese themselves; and I have every reason to suppose they were telling me the truth; these pipes will last under ground for 10 or 20 years. They lay them—should it be deemed necessary—from two to three feet under ground, and surround the pipes with a layer of ashes 2 to 3 inches deep. This last is done in order to protect them from the attacks of worms, etc.

35. *Q.* (*Sir Thomas Higham.*)—You have come to India now for the purpose of developing this system?—Yes. I did so because certain negotiations I had been carrying on with the Russian authorities in Port Arthur—with a view to the introduction of the Kazusa system there—miscarried.

36. *Q.* These places where your system is tried are places only where the geological configurations are favourable to artesian wells. You would not expect it to succeed in great alluvial plains like the Ganges delta?—There are artesian configurations there too, and I don't see why experiments should not be made. It is not only for that, but supposing a native wants to put down a *pakka* well, he finds it not only a very expensive undertaking, but moreover a risky one, for he does so more or less without possessing data as to the subsoil, etc. Why not have this system introduced into India for testing strata. It would be useful for trial borings or for increasing the supply in existing wells. Then again the system is so simple that the whole of the machinery could not only be made by an Indian *mistri*, but could be kept in order quite easily by villagers. There is such little intelligence required to work the system, and the simplicity and cheapness of the whole thing should appeal to every one.

37. *Q.* You would have to bring your bamboos out from Japan?—This bamboo (shown) as I have already said is Indian and is the same as the Japanese bamboo. Of course for the first few years you would have to pick and choose your bamboos here, but then you could cultivate them later on and have bamboo plantations as the Japanese do in Kazusa.

38. *Q.* Would you be willing to undertake boring in India at contract rates?—Until I know the strata I have to tackle I would not take any contract.

39. *Q.* You would not take any risk?—No.

40. *Q.* You would not work on the system—"no water, no pay"?—I don't know the conditions here, but what I do know is that the thing is very simple, and I cannot see why it should not be introduced into India.

41. *Q.* Supposing they have to go through very light sandy soil?—I had one of the best American experts ask me about this very same thing. I have told you how they go through the process. They first of all choose the spot that the bore hole has to be taken down. They then dig down the hole 6 or 8 feet deep and into this they insert a cylinder of wood, iron or sometimes of very big bamboo; a foot and a quarter of that cyliner will be above ground; and 6 or 7 feet under ground. Around that cylinder is a tube. Then they erect a scaffolding around and over it, and while they are boring, a boy in attendance is kept busily at work pouring down the bore-hole water with lots of clay dissolved in it. In sandy soil or any other soil, this clay not only acts as a lubricant for the tools, but by depositing itself on the sides of the well braces them up. The wells go down 300 feet or more without tubing, and after striking water the bamboo piping is put down joint by joint. The operation is not a lengthy one, and after a time the clay settles down and forms a well round these bamboos and preserves them.

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42. *Q.* (*Mr. Muir-Mackenzie.*)—Would this do just as well for rock?—The Japanese told me that in this Echigo trial boring for oil, 800 feet out of the 1,200 feet they went through was rock. I only go on their report for this, but when I put down a 300 feet well myself I struck a stratum of pebbles, some 20 feet under ground, some of which must have been very large. At 80 feet below the surface I struck a stratum of stones, which was very hard, and at 180 feet we struck disintegrated granite, after which we struck the water level. It would go through *kankar* very very easily.

43. *Q.* How long does it take to put down a well?—Ten days to a fortnight. I have put one down in 11 days, that was the first time.

44. *Q.* What is it you would like the Government of India to do?—To give me a contract to form a school for the introduction of this system and to place some men under me for instruction.

45. *Q.* (*The President.*)—Have you made any proposition to the Government of India?—Yes, but I have received no decided answer as yet.

46. *Q.* Would you be prepared to give your services to Government for one or two months?—Yes, if I am given a contract. My idea would be to bring over a couple of Japanese to do the mechanical part of the work and show the natives of India the system. One of the Public Works Engineers might be deputed to report on the system, and if he reported favourably, the school could be formed.

47. *Q.* Do I understand that your proposal is that, assuming that you have your instruments ready, you would erect machinery and carry out a boring at some place to be agreed upon for a certain salary while this work was going on, that after a certain time, supposing you satisfy the authorities here that your system is a good one, you should be put in charge of an undertaking to teach the natives of India the system for a period to be settled?—Yes, that is exactly it.

48. *Q.* You have not made a proposal to the Government of India?—Not quite on the lines just indicated.

49. *Q.* When would you be ready to commence work?—At the commencement of the coming year.

Mr. E. B. Alexander.

MR. E. B. ALEXANDER, Commissioner of the Meerut Division.

(*Meerut, 19th December 1902.*)

(*Replies to printed questions.*)

The one tract regarding which I feel competent to express an opinion is that comprising the Sadabad tahsil of the Muttra district and the Hathras-Iglas tahsils of Aligarh.

2. I saw a great deal of the Sadabad tahsil in 1883-84 after a period of drought, and I have seen a little of the Aligarh tahsils recently.

3. In the whole tract, but more especially in Sadabad tahsil, the potential irrigation from wells used to be much better 30 years ago than it is now.

The reason seems to be that in about 1880 after some years of heavy rainfall the drainage of the Kali Nadi was much improved, and rain water, which used to percolate very slowly through the surrounding country, was run off very much more quickly. The effect of these measures was to lower the water level some three or four feet even at a distance of thirty miles away from the *nadi*.

Added to this the effect of a cycle of years of deficient rainfall and the drop in the water level brought it down either into a stratum of loose fluid sand in which *kachcha* wells could not work, or into a stratum full of ammonia or other substances injurious to crops.

4. The extraordinary extent to which the quality of water varies in wells at quite short distances from each other in the Muttra district is a well known fact, and to considerable, though less extent, the quality of water will vary in the same well according to the depth to which the surface of the water sinks.

5. The whole tract is one which, in my opinion, calls most urgently for some extension of the canal system or for an entirely new canal.

6. I am afraid the amount of water available in the Jumna is not sufficient to make a new canal possible, and whether the present system could be extended so as to pass through this tract is a point on which I can express no opinion.

I can only say that it is extremely desirable that the extension should be made if it is possible.

7. No private enterprise—at least none which the local zamindars or cultivators can command—can supply the need; but, on the other hand, none of the other obstacles mentioned in question 1 exist as far as I am aware.

8. There is certainly a strong desire for it. The increase resulting in the value of produce would be very large, and I should say that an average water-rate of five (5) rupees an acre might be charged, and that Government would still reap a substantial advantage at the next settlement in the shape of enhanced revenue, as cultivation would extend and rents would rise even though the water-rate levied was five rupees an acre.

9. As regards the construction of masonry wells, the small size of the average tenant's holding and his want of means render him, as a rule, unable to incur the expense at any profit to himself. It is therefore to the zamindars that we must look, and unfortunately very few of them care to spend money in this way. If some power could be given to the District Officer (subject to proper checks) to insist on landlords constructing irrigation wells, or to have them constructed himself and enhance the Government revenue by a sum which would repay the expenditure *plus* interest within twenty years, I believe the policy would be a good one. The experiment could be tried at first in a few districts in which there are officers of experience, and the maximum cost of a well as also the number to be made in a given area or at one landlord's expense might be limited.

10. As regards tanks, such little experience as I have is not favourable. They seem to me generally to fail in a year of drought unless they are natural lakes of considerable size. Where, however, there are hills in which large reservoirs can be constructed, I can quite understand their being very useful. My remarks apply only to the common tank dug as a famine relief work which, though it is often useful as retaining enough water to keep the village cattle alive, is seldom of appreciable use for irrigation.

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1. *Q.* (*The President.*)—Do you think Mr. Brownrigg's feeling that, in a wet year, when there was no interest in irrigation, the canal was not only negative, but was doing positive harm, is warranted?—Some time ago when canal distributaries were taken out across drainage, no doubt that did do harm; but that has been rectified. I do not think any harm would result now even in a year of heavy rainfall.

2. *Q.* In answer to question 3 you say—"In the whole tract, but more specially in Sadabad tahsil, potential irrigation from wells used to be much better 30 years ago than it is now," due to the Kali Nadi?—That was the popular impression; a large number of irrigation channels were made in the Aligarh District and the Kali Nadi was straightened and deepened, and that happened before the fall in the water-level took place. and popular opinion attributed the latter to the channels and the general drainage in Aligarh.

3. *Q.* My recollection is that we deliberately stopped the extension of irrigation, because it was interfering with wells?—Yes. I remember that. The people did not want it brought down to Sadabad; the channel had been taken through part of Muttra District and was abandoned.

(*Mr. Muir-Mackenzie.*)—Is not that an example of the original mistake of refusing water to a well irrigated tract?

(*The President.*)—I think it is. There is no doubt that the water-level has fallen enormously. It used to be 35 or 40 feet and now it has gone down to something like 70 or 80.

4. *Q.* You say in reply to question No. 8—"There is certainly a strong desire for it (irrigation). The increase resulting in the value of produce would be very large, and I should say that an average water-rate of five rupees an acre might be charged, and that Government would still reap a substantial advantage at the next settlement in the

shape of enhanced revenue, as cultivation would extend and rents would rise even though the water-rate levied was five rupees an acre." Do you think that the canal water-rates are too low, that they might well be raised?—Where they are newly introduced. You could not very well raise them where you have had them a long time and rents have adjusted themselves accordingly.

5. *Q.* The full value of the irrigation is being got in the Revenue Department instead of in the Public Works Department; the assessments have been raised in consequence?—Yes, but the landlord gets half the increase in rent. He would not get any of the water-rate.

6. *Q.* (*Mr. Roberts.*)—Would not a rise in canal rate be followed by a fall in rents?—It might be, but the tenants would suffer before that happened, *i.e.*, in tracts where the low rates have been in force some time and rents have been adjusted on this basis.

7. *Q.* (*The President.*)—In reply to question 9 you say—"If some power could be given to the district officer (subject to proper checks) to insist on landlords constructing irrigation wells, or to have them constructed himself and enhance the Government revenue by a sum which would repay the expenditure *plus* interest within 20 years, I believe the policy would be a good one." You think that the present facilities for *takavi* are not sufficient?—The cases I was thinking of were rather those where you have a lot of occupancy tenants with no very large holdings, men of no great substance who could not afford a *pakka* well, and where the zamindar simply will not build one because they are occupancy tenants.

8. *Q.* Is Government over-particular about security with these occupancy tenants?—Yes. I agree with Mr. Brownrigg that Government, in some places where a well can obviously be made, because wells have already been made and worked, might freely put in money there and charge a water-rate. In the same way I think it might lend money to occupancy tenants without very much security.

9. *Q.* The district officers must be able to form an estimate of the character of the tenants as to whether they are likely to pay up?—Yes, but the constant changes of officers are rather against it.

10. *Q.* You distinctly advocate an extension of wells where that can be done as a famine protection?—Yes. There is certainly a possibility of making more wells. I never saw any Court of Wards estate which did not require more wells than were in existence when it came under charge. The great bulk of wells are made by zamindars for their own land—*Khudkhast*, and others by zamindars with non-occupancy tenants from whom they get enhancements easier. The places where there are occupancy tenants are where wells are wanted as a rule. I do not think that it would be safe to make them experimentally in tracts where the expense is likely to be considerable, because the Government would probably lose its money, but where there are wells still working and it is only a matter of giving more at a moderate cost, they might be made with advantage.

11. *Q.* Do you think that many men make a bad shot at a well?—Over this tract it was extraordinary to see the difference in the distance of the water and you might have one well with perfectly sweet water and 200 yards away you would have another with bitter water. Borings would give a certain guide. I have used the boring tools of the Agricultural Department.

12. *Q.* Is there a large demand for them?—I believe it is increasing, but I do not suppose it is a large demand.

13. *Q.* Enough to keep such materials at the head-quarters of each district?—Not every district, but where *pakka* wells are habitually made.

14. *Q.* Would it be judicious on a canal like the Ganges to restrict the area to be watered in a village; is mischief done by over-watering?—In Meerut and elsewhere we are told that 70 or 80 per cent. of the land is now watered every year. We have had a sequence of dry years, and nothing of that sort would be advisable now, with a cycle of wet years extensive canal irrigation might aggravate a rise in the water level, and with it the efflorescence of *reh* on the surface. A restriction of canal irrigation might then be temporarily advisable.

15. *Q.* People say the irrigated lands are not half as well protected as they used to be. Is there anything in it?—It is a matter of wet and dry years again. Now after a cycle of dry years the demand for water is enormous, and the duty much increased, hence the complaints.

16. *Q.* Is there any artificial manure used in these parts for constant waterings?—Yes, but the indigo refuse which was very largely used in many places is much scarcer now than it used to be owing to the decline in the manufacture.

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17. *Q.* (*Mr. Muir-Mackenzie.*)—With regard to the security question, supposing tenants were given a good long period in which to repay, would not a crop be sufficient guarantee for the annual instalments?—The difficulty with the tenant is his liability to get into arrears with his rents and be ejected, and if he were a dishonest man, he might give a relinquishment.

18. *Q.* He would not give up land on which he had built a well if he could help it?—No, I do not think he would, but the holdings are very small, and you would have to deal with more than one man's holding irrigated from the one well. If you took joint responsibility, then the crop might be enough.

19. *Q.* Would it be difficult to get joint agreements?—That is the difficulty; they are rather suspicious of each other.

20. *Q.* Could more be done in the way of general advances if officers went in for a policy of active inducement, such as Mr. Brownrigg described?—Yes.

21. *Q.* Would you advocate such a policy or wait upon the demand?—It is best to wait upon the demand, except in a few cases where you might put a certain amount of pressure on the zamindar to induce him to make wells where they ought to be, but are not, made.

22. *Q.* If you wait upon the demand, the *takavi* advances for Aligarh would be about Rs. 3,000 or Rs. 4,000 a year?—I should like Government to have the power to make wells in some cases, as I have said before.

23. *Q.* In addition, would it not be a good thing if a policy of active inducement were entered on in order that in Aligarh you might increase the amount of your advances?—You could increase it, but your active tahsildar would make people take money who did not want to.

24. *Q.* But your active Sub-divisional officer?—Yes, but they change so often that you might have to fall back on the tahsildar.

25. *Q.* Would it be worth while to have a more or less permanent man in districts where there is scope for well construction?—As a rule, the people have got a great number of wells already made in such tracts.

26. *Q.* You do not think that any active policy of inducement would succeed?—Not unless you had some power behind it to make the people think that if they would not do it Government would do it for them.

27. *Q.* You would like Government to make wells in well tracts, but not to see experiments made in less promising places?—The people know enough about wells, and it is not necessary to find out more about them; but if a man was willing to go to the expense of making experiments, Government might help him; I would not put it all on Government.

28. *Q.* Government is apparently not unwilling to make a canal in an unpromising tract in the hopes of something coming of it, and what I hope to get your opinion for is that it would not be unwise to make similar ventures for wells?—The people know a great deal about wells; the canal experiments they cannot make for themselves.

29. *Q.* (*Mr. Rajaratna Mudaliar.*)—Why are the landlords so indifferent about the construction of wells?—Some are on good terms with their tenants and some on bad.

30. *Q.* Under existing conditions, does it pay landlords sufficiently to make wells?—In many cases the well which was made 20 years before, and from which their land was irrigated is now falling in, and the tenant is paying a rent fixed when the well was in full work. The zamindar is not losing anything by the well falling in; the tenant is, and though one would naturally expect the tenant to apply for abatement of rent he practically very rarely does so. The number of cases of abatement of rent is extraordinarily few; not one to a hundred of enhancements.

31. *Q.* Does it pay a landlord to spend large sums in constructing new wells?—That would depend upon his relations with his tenants. If he had non-occupancy tenants, he would probably make wells.

32. *Q.* But even in the case of occupancy tenants he can enhance his rent?—That depends on whether the tenant is already paying a wet rate.

33. *Q.* I mean where there are no wells?—Yes, he could enhance the rent, but the cases I refer to are those where there is bad feeling between the zamindar and tenant and the possible enhancement would not in such cases be a sufficient

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inducement, especially as some of the tenants might refuse to use the well even if he made it.

34. *Q.* The landlord now enjoys a period of exemption?—In Aligarh Rs. 2 per acre were generally let off on area newly irrigated from wells constructed since the last settlement.

35. *Q.* At the end of the exemption period the landlord gets only half the increase and the other half goes to the Government?—If the well is still working at the end of 30 years.

36. *Q.* That is on private improvements effected by the landlord?—Government and landlord get half each. The tenant is the man who pays.

37. *Q.* Would it be an inducement to the landlord if the Government share in the increase were given over to him?—You cannot do that after a period of 30 years, because not the well only, but the change in prices and a hundred other things which affect the assets have to be considered.

38. *Q.* But the landlord has spent the capital and should be allowed to receive the full benefit of it?—Yes, and perhaps Government think that after 30 years he has received the full benefit.

39. *Q.* But after that period, a certain portion of the enhancement would still be on account of the landlord's improvements?—If the well is still working.

40. *Q.* Assuming that, why should Government get a share of that enhancement? If that portion were surrendered to the landlord, would it induce him to make more wells?—I think 30 years is a sufficient inducement, and I do not think the enhancement due to the well can be separated then.

41. *Q.* (*Mr. Roberts.*)—A landlord is not entitled to all the benefit; all he is entitled to is to get a reasonable profit from his improvement. He is only co-sharer with the Government after all in the land?—I think the 30 years' term is quite sufficient.

42. *Q.* Is that term sufficient to recoup him?—It ought to be.

43. *Q.* If so, is that all he is entitled to?—Certainly.

44. *Q.* (*Mr. Muir-Mackenzie.*)—Do you know whether Moradabad suffered much in 1878?—Not very much.

45. *Q.* Is there anything to prevent a similar distress as in 1878 occurring again in Rohilkhund generally? The well irrigation is not large. There seems to be no idea of extending canal irrigation in Rohilkhund. Are you satisfied with that?—I do not know what would be possible myself.

46. *Q.* If a canal were brought into the tract, would it be a good thing?—Yes. There was a little experiment made in 1896 in Bareilly District. The zamindars used to make a *bund* across the river, but they gave it up, as they could not agree among themselves, and I wrote to Mr. Coles and the Irrigation Department took it up, and made the *bund* on behalf of Government and it irrigated a considerable area. That was a small experiment, about 3,700 acres, at a very small cost.

47. *Q.* But in 1877-78 the mortality was very considerable in Rohilkhund?—There was a certain amount in Moradabad due to famine, but not much.

48. *Q.* (*The President.*)—From my figures in the district of Bijnor where the canal is on a very small scale, 12,081 acres were watered in 1878-79 and now there is 25,763, and in Bareilly in 1877-78 there were 30,676 acres and in 1896, 129,083. Do you consider the administration of the Canal Department satisfactory as regards meeting the wants of the people?—Yes, on the whole. Sometimes when distributaries are altered there are individual hardships, because some whose holdings were irrigated do not get the same amount through the new channel. That wants looking into a little more.

49. *Q.* Do complaints come up often to that effect?—There are complaints, not often.

50. *Q.* Do you have any complaints about incorrect measurement?—Very seldom.

51. *Q.* Do the native Deputy Magistrates do their work fairly well?—Yes.

52. *Q.* Are famine relief programmes kept up in your division?—Yes, but it is a division so well protected that we have really very little we could do. The large tanks we have down on the list of the Aligarh District, about ten tanks each to cost Rs. 56,000, will not be the least good, because they would not hold sufficient water for irrigation purposes in a dry year. The programmes are kept up, but it is difficult to get any works of real permanent good.

53. *Q.* Do the programmes come up to you?—The village works ones do.

54. *Q.* And there is some effort to keep them up to date?—Yes; changes every year.

55. *Q.* (*Sir Thomas Higham.*)—What are provided for as village works?—The digging of small tanks, which would keep the cattle alive are useful works, but a big irrigation tank would be a failure; nine cases out of ten.

56. *Q.* These are practically the only village works?—And a certain amount of road work and filling in of insanitary holes and levelling mounds in some places.

Mr. H Marsh.

MR. H. MARSH, C.I.E., Chief Engineer, Irrigation Branch, United Provinces.

(*Meerut, 20th December 1902.*)

Note, dated 23rd October 1902, on the expansion of irrigation from existing works.

About 20 years ago attempts to improve the economy of water was actively carried out by Captain Hall in Cawnpore Division.

He amalgamated watercourses and did a lot of good. His fault, however, was that he gave too small apertures in the outlets, and ran the channels constantly.

2. As Executive Engineer in Etawah Division I attempted a similar task in 1887 and 1888, and was rewarded with great success. Each distributary and its commanded area was mapped out on large cloth sheets,* which delineated all the watercourse ramifications, lift, flow, and well irrigation, as well as drainage and waste soil. Skilled Deputy Magistrates prepared statements of the annual irrigation effected by each watercourse, and submitted statements of superfluous outlets. These were then examined on the ground by myself and my Assistants, and final orders issued for the removal of only those that were redundant.

In doing this the support of the District Magistrates was invited, and of course the levels of the country were also considered.

3. The alterations were effected as far as possible in the dead time of the irrigating seasons, so as to inconvenience the cultivators as little as possible.

4. Needless to say many petitions were submitted, but they were all carefully looked into and trouble mitigated. The result of this weeding was that—

(*a*) the number of outlets was reduced from 7,500 to 4,500, and an immensity of waste prevented;

(*b*) "tatils" were abolished and power of the petty officials in levying blackmail was minimized.

(*c*) The Canal Officer and his staff were spared the very serious trouble of passing supply to the tails. This gave them time to prepare projects for drains, minors, etc., and for improving the sections of distributaries.

5. The result of these salutary measures caused much satisfaction to Colonel Forbes, Chief Engineer, and Mr. Beresford, Superintending Engineer, and Colonel Corbett, R.E. The people rejoiced openly over the ease with which they obtain their irrigation and their freedom from oppression. Orders were issued to carry out similar measures elsewhere, but for some reason not much progress was made.

6. The benefit to Government was great, as it was possible to equalize the distribution of water and give as much supply at the tails of the channels as at the heads.

The economy of volume allowed for extensions elsewhere. One test of the benefit was that the record *rabi* area in Etawah Division rose from 170,000 acres to 230,000† acres, although the supply was diminished,

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* Typical maps will be laid before Commission. H. M.

† This is the true criterion of the efficiency of a distributary-system. Average areas are no guide, as in such years water is superabundant. H.

7. In 1892 I returned from furlough and commenced similar operations in Bulandshahr.

In one year 1,700 outlets were cut out of a total of 5,700 and *tatils* abolished.

In three years the mileage of Government distributaries was increased from 611 to 720.

The mileage of drains rose from 236 to about 500.

The salutary result of these measures was that the record *rabi* area rose from 134,000 to 180,000 acres and the *kharif* from 88,000 to 106,000.

Tatils used to be so strict in this division that murders were frequent, and petty canal officials amassed large sums by illegal methods.

All these evils disappeared, and, combined with the sanitary effects, caused a striking increase in the population.

Comparing the census of 1891 with 1901 we find the figures are—

Zila Bulandshahr	1891	. 949,914	
„ „	1901	. 1,138,101	
	Increase	. 188,187	or 17 per cent.

8 Independent of reducing outlets, the beds of the channels had to be regarded and enlarged in a scientific manner from head to tail. This latter work was of course very laborious.

9. In 1896 I was transferred to Roorkee Division, and there again instituted similar procedure. The work only took a year. Here again the drought *kharif* area rose from 50,000 acres to 62,000* acres, and the *rabi* from 62,000 acres to 75,000* acres.

* That is to say, the record area was raised 24 per cent.

H. M.

10. It may here be pointed out that the great secret for increasing areas is not only to prevent waste, but to devise channels of sufficient carrying power. By this means a high volume in the river can be utilized in times of good demand, and the irrigation quickly effected.

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I looked up his notes, and found that he had only been able to give a slope of ·56 per mile instead of his favourite 1·04 per mile. He lamented the fact, but the result was that it gave me the key for an important reform.

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I attach a special note on this enterprise.* The burden of it is that for an outlay of Rs. 21,000 we have reduced the required discharge from 42 cusecs to 19 cusecs, and have increased the area.

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(*a*) want of projects;

(*b*) want of establishment.

As regards (*a*), I may say that great uneasiness was created some four or five years ago by some officers suffering pecuniarily on account of revised estimates or on account of sanctioned sums being exceeded. No doubt strict inquiries were made, and no doubt some errors of omission and commission came to light, and led the Lieutenant-Governor to consider it was right to punish the offenders; but the effect was very pernicious, as the faults were such as might have been dealt with more mildly, and many officers considered it was safer to do nothing than to be zealous, push on schemes, and then probably get into trouble. The Irrigation officer has frequently to accept grave responsibility, and incur expenditure in anticipation of sanction. But, when cases were reported of men being mulcted for such action, the natural result was to suppress zest and keenness to the detriment of Government interests.

I may say that this feeling is now passing away, but it is not easy to rub out such apprehensions when once excited in the rank and file of a big department.

3. The want of establishment is an important question and is no doubt well understood by Government. I think perhaps no branch of the Public Works Department is suffering from it more than in the United Provinces Irrigation. The reasons are due more to the losses we have suffered than to want of recruitment.

These losses are bound to increase, as unfortunately the nature of the work has got the reputation of being more unhealthy, more isolated, and more expensive than any other branches of the Public Works Department. The result is that, unless a man is a bachelor and very keen and very interested, he strains every point to get out of the Irrigation Branch, although the work is so interesting.

4. For example, if we take the Railway Branch, a married man is saved a good deal of expense by being able to rail himself and his family free to the seaport or to the hills. On the sea, too, he gets special rates. Moreover, the Railway Engineer has many chances of deputation on guaranteed lines with extra pay, whereas in the Irrigation there is no outlet.

5. Again, in the General Branch the Engineer has many chances of hill work, whereas there are practically none in the Irrigation. Then the work of the former keeps a man mostly in a large town, where a house is found to be of use, and his family are contented. Granted that he has long distances of roads to inspect, but then it is possible to do this cheaply and quickly in a dogcart or on a bicycle. In the Irrigation Branch the officer has to leave the station for months at a stretch, and is thus often compelled to keep up two establishments instead of one. In time this state of affairs leads frequently to domestic unhappiness, and very often to debt.

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* Not printed.

Mr. E. B. Alexander.

inducement, especially as some of the tenants might refuse to use the well even if he made it.

34. *Q.* The landlord now enjoys a period of exemption?—In Aligarh Rs. 2 per acre were generally let off on area newly irrigated from wells constructed since the last settlement.

35. *Q.* At the end of the exemption period the landlord gets only half the increase and the other half goes to the Government?—If the well is still working at the end of 30 years.

36. *Q.* That is on private improvements effected by the landlord?—Government and landlord get half each. The tenant is the man who pays.

37. *Q.* Would it be an inducement to the landlord if the Government share in the increase were given over to him?—You cannot do that after a period of 30 years, because not the well only, but the change in prices and a hundred other things which affect the assets have to be considered.

38. *Q.* But the landlord has spent the capital and should be allowed to receive the full benefit of it?—Yes, and perhaps Government think that after 30 years he has received the full benefit.

39. *Q.* But after that period, a certain portion of the enhancement would still be on account of the landlord's improvements?—If the well is still working.

40. *Q.* Assuming that, why should Government get a share of that enhancement? If that portion were surrendered to the landlord, would it induce him to make more wells?—I think 30 years is a sufficient inducement, and I do not think the enhancement due to the well can be separated then.

41. *Q.* (*Mr. Roberts.*)—A landlord is not entitled to all the benefit; all he is entitled to is to get a reasonable profit from his improvement. He is only co-sharer with the Government after all in the land?—I think the 30 years' term is quite sufficient.

42. *Q.* Is that term sufficient to recoup him?—It ought to be.

43. *Q.* If so, is that all he is entitled to?—Certainly.

44. *Q.* (*Mr. Muir-Mackenzie.*)—Do you know whether Moradabad suffered much in 1878?—Not very much.

45. *Q.* Is there anything to prevent a similar distress as in 1878 occurring again in Rohilkhund generally? The well irrigation is not large. There seems to be no idea of extending canal irrigation in Rohilkhund. Are you satisfied with that?—I do not know what would be possible myself.

46. *Q.* If a canal were brought into the tract, would it be a good thing?—Yes. There was a little experiment made in 1896 in Bareilly District. The zamindars used to make a *bund* across the river, but they gave it up, as they could not agree among themselves, and I wrote to Mr. Coles and the Irrigation Department took it up, and made the *bund* on behalf of Government and it irrigated a considerable area. That was a small experiment, about 3,700 acres, at a very small cost.

47. *Q.* But in 1877-78 the mortality was very considerable in Rohilkhund?—There was a certain amount in Moradabad due to famine, but not much.

48. *Q.* (*The President.*)—From my figures in the district of Bijnor where the canal is on a very small scale, 12,081 acres were watered in 1878-79 and now there is 25,763, and in Bareilly in 1877-78 there were 30,676 acres and in 1896, 129,083. Do you consider the administration of the Canal Department satisfactory as regards meeting the wants of the people?—Yes, on the whole. Sometimes when distributaries are altered there are individual hardships, because some whose holdings were irrigated do not get the same amount through the new channel. That wants looking into a little more.

49. *Q.* Do complaints come up often to that effect?—There are complaints, not often.

50. *Q.* Do you have any complaints about incorrect measurement?—Very seldom.

51. *Q.* Do the native Deputy Magistrates do their work fairly well?—Yes.

52. *Q.* Are famine relief programmes kept up in your division?—Yes, but it is a division so well protected that we have really very little we could do. The large tanks we have down on the list of the Aligarh District, about ten tanks each to cost Rs. 56,000, will not be the least good, because they would not hold sufficient water for irrigation purposes in a dry year. The programmes are kept up, but it is difficult to get any works of real permanent good.

53. *Q.* Do the programmes come up to you?—The village works ones do.

54. *Q.* And there is some effort to keep them up to date?—Yes; changes every year.

55. *Q.* (*Sir Thomas Higham.*)—What are provided for as village works?—The digging of small tanks, which would keep the cattle alive are useful works, but a big irrigation tank would be a failure; nine cases out of ten.

56. *Q.* These are practically the only village works?—And a certain amount of road work and filling in of insanitary holes and levelling mounds in some places.

Mr. H Marsh.

MR. H. MARSH, C.I.E., Chief Engineer, Irrigation Branch, United Provinces.

(*Meerut, 20th December 1902.*)

Note, dated 23rd October 1902, on the expansion of irrigation from existing works.

About 20 years ago attempts to improve the economy of water was actively carried out by Captain Hall in Cawnpore Division.

He amalgamated watercourses and did a lot of good. His fault, however, was that he gave too small apertures in the outlets, and ran the channels constantly.

2. As Executive Engineer in Etawah Division I attempted a similar task in 1887 and 1888, and was rewarded with great success. Each distributary and its commanded area was mapped out on large cloth sheets,* which delineated all the watercourse ramifications, lift, flow, and well irrigation, as well as drainage and waste soil. Skilled Deputy Magistrates prepared statements of the annual irrigation effected by each watercourse, and submitted statements of superfluous outlets. These were then examined on the ground by myself and my Assistants, and final orders issued for the removal of only those that were redundant.

In doing this the support of the District Magistrates was invited, and of course the levels of the country were also considered.

3. The alterations were effected as far as possible in the dead time of the irrigating seasons, so as to inconvenience the cultivators as little as possible.

4. Needless to say many petitions were submitted, but they were all carefully looked into and trouble mitigated. The result of this weeding was that—

(*a*) the number of outlets was reduced from 7,500 to 4,500, and an immensity of waste prevented;

(*b*) "tatils" were abolished and power of the petty officials in levying blackmail was minimized.

(*c*) The Canal Officer and his staff were spared the very serious trouble of passing supply to the tails. This gave them time to prepare projects for drains, minors, etc., and for improving the sections of distributaries.

5. The result of these salutary measures caused much satisfaction to Colonel Forbes, Chief Engineer, and Mr. Beresford, Superintending Engineer, and Colonel Corbett, R.E. The people rejoiced openly over the ease with which they obtain their irrigation and their freedom from oppression. Orders were issued to carry out similar measures elsewhere, but for some reason not much progress was made.

6. The benefit to Government was great, as it was possible to equalize the distribution of water and give as much supply at the tails of the channels as at the heads.

The economy of volume allowed for extensions elsewhere. One test of the benefit was that the record *rabi* area in Etawah Division rose from 170,000 acres to 230,000† acres, although the supply was diminished,

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* Typical maps will be laid before Commission.
H. M.

† This is the true criterion of the efficiency of a distributary-system. Average areas are no guide, as in such years water is superabundant.
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7. In 1892 I returned from furlough and commenced similar operations in Bulandshahr.

In one year 1,700 outlets were cut out of a total of 5,700 and *tatils* abolished.

In three years the mileage of Government distributaries was increased from 611 to 720.

The mileage of drains rose from 236 to about 500.

The salutary result of these measures was that the record *rabi* area rose from 134,000 to 180,000 acres and the *kharif* from 88,000 to 106,000.

Tatils used to be so strict in this division that murders were frequent, and petty canal officials amassed large sums by illegal methods.

All these evils disappeared, and, combined with the sanitary effects, caused a striking increase in the population.

Comparing the census of 1891 with 1901 we find the figures are—

Zila Bulandshahr 1891	. 949,914	
„ „ 1901	. 1,138,101	
Increase	. 188,187	or 17 per cent.

8 Independent of reducing outlets, the beds of the channels had to be regarded and enlarged in a scientific manner from head to tail. This latter work was of course very laborious.

9. In 1896 I was transferred to Roorkee Division, and there again instituted similar procedure. The work only took a year. Here again the drought *kharif* area rose from 50,000 acres to 62,000* acres, and the *rabi* from 62,000 acres to 75,000* acres.

* That is to say, the record area was raised 24 per cent.

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I can substantiate these remarks by enumerating six valuable officers who left the Irrigation Branch during the last ten years, so as to avoid the isolation and expenses of work in the jungle. I may go further than this, and say that the same officers have benefited largely by the transfer.

6. In addition to the above, three picked men have gone to Egypt, two selected men have joined the Sanitary Department, four have been transferred to the General Branch, and now one of the best Assistants has obtained a Railway appointment.

7. It may be urged that this should not be allowed, but I think that such a restriction would be very unwise. A good officer should be allowed to get the value of his services, and if Government would reward the Irrigation Engineer according to his work, they would not lose him when his training and experience have rendered him valuable.

8. The remedial measures I propose are not expensive and are, I think, well deserved. Besides being an Engineer, the Irrigation Officer has large revenue duties to perform, and therefore stands on a different basis from the Railway or General officer. Some of the divisions bring in a revenue of 7 or 8 lakhs, and yet the Engineer, who is responsible for it, gets nothing more than if he had ordinary engineering work to perform. I have gone through the mill myself, and know the amount of vernacular and statistical work that had to be done. Personally I liked it, and this revenue training was really the secret of any success I obtained in improving irrigation channels.

Some authorities have advised a separation of the work as in the Railway, where there are distinct Revenue and Engineering branches. But this is not sound, as the Irrigation Officer would quickly lose touch with the people, their cultivations, and, in fact, with the value of his work. My scheme is to pay the Divisional Engineer for this special work, and then the trained men will not be lost. The Sub-divisional Officer is an important factor in the Irrigation system, but generally his salary is good enough. All that is wanted in his case is to prove that the charge of a revenue division is a prize worth looking forward to, and will only be given to a trained and efficient officer.

9. The scheme I propose is that the Divisional Officer on a running canal should get, in addition to his grade pay, a house rent-free and a charge allowance of Rs. 100 to Rs. 200 a month. There are at present 16 revenue divisions in the United Provinces Irrigation; so the annual cost of the concession would not exceed Rs. 40,000. This is an absolute trifle compared to the revenue for which these 16 officers are responsible, and which varies between 70 and 100 lakhs. Even that large sum is itself small when pitted against the value of the crops raised and the protection afforded to the Provinces.

10. Colonel Corbett, R.E., who served in this Province for thirty-one years, and who lived the jungle life of a canal officer for a longer period than most men, used to say that in some charges a thoroughly efficient Sub-divisional Officer could raise the annual revenue secured by a merely ordinary predecessor by half a lakh. In other words, a keen, zealous, trained Assistant was worth Rs. 50,000 to Government, and of course ten times that amount to the irrigating community of his sub-division. Now in a canal division there are generally three Sub-divisional Officers, and, considering that fact in connection with Colonel Corbett's theory, it is evident how necessary it is to retain trained men in the Department and to remunerate them properly.

11. In conclusion, I beg to point out that these establishment matters are brought forward under cover of paragraphs I and II of the Commission's Memorandum, because I see the members wish to discover what steps are necessary to develope Irrigation projects and what are necessary to remove obstructions to the prosecution of the same.

To my mind no reform will be so far-reaching as what I have sketched. It will make the Department worth serving in, and will prevent the exodus of trained officers, which has left the staff in a depleted condition.

Note No. C.-201, dated 21st March 1902, by H. Marsh, Esq., C.I.E., Superintending Engineer, 3rd Circle, Irrigation Works, United Provinces of Agra and Oudh, on the distribution of water-supply between the Western and Eastern Jumna Canals.

In the newspaper report of the evidence taken by the Irrigation Commission at Delhi, it is stated that Mr. Mullaly, Superintending Engineer, recommended a redistribution of the Jumna water-supply.

Apparently that Officer considered the Western Jumna Canal should get a larger proportion than it does.

2. At present the Western Jumna receives twice the volume of the Eastern Jumna, and before any decision is arrived at, I venture to submit that it would be well to see which canal makes the better use of its share.

In most years it would be difficult to do this, as partial showers of rain slacken demand on one side of the river, and then the surplus volume goes to the other side.

3. But in the cold weather of 1899-1900 there was a raging demand for *rabi* sowings and standing sugarcane, from September to January. During that time the river kept on falling, and throughout this important agricultural season its volume remained lower than it had ever been before.

Consequently every drop of water was eagerly utilized, and the share of each Province was jealously watched.

Here then we have an exact test of the utilization of supply.

	Rabi.	Sugarcane.	Total.
	Acres.	Acres.	Acres.
The Punjab Canal, (Western Jumna) irrigated .	314,705	73,167	387,872
The N.-W. P. Canal, (Eastern Jumna) irrigated .	167,345	63,362	230,707

If the Punjab Canal had utilized its double volume with the same efficiency as the N.-W. Provinces Canal, it should show an acreage of twice that of the latter.

In other words its area should be 461,414 acres instead of 387,872 acres.

These figures work out to a proportion of 100 to 84 and show that for a certain unit of volume the N.-W. P. Canal covered 100 acres to every 84 of the Punjab Canal.

During the last two years the Eastern Jumna Canal distributaries have been undergoing a process of remodelling which has no doubt improved its efficiency.

In the current year, 1901-02, its area and revenue will top all records, and I therefore think it will give even a better account of itself when a similar chance for comparison can be again instituted.

5. I may mention that two years ago I pointed out these facts to some of the Punjab Irrigation Engineers. Their defence was that the discrepancy was due to the fact that the distribution system of the Western Jumna was so much more widely carried out, and that it travelled over a thirstier country.

Against this argument may be brought forward paragraph 23 of Mr. Preston's Inspection Notes of the Eastern Jumna for March 1899. Mr. Preston thought the Eastern Jumna would be improved by extensions, and wrote as follows :—

> "Experience on the Western Jumna Canal in the Punjab has shown that water can be made available, by an improvement of the duty, if new channels are to be constructed, and it seems possible the same may be done also in the case of the Eastern Jumna Canal."

I am of the same opinion, and feel hopeful that the more extensions we carry out, the greater will be the economy obtained.

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1. *Q.* (*The President.*)—Do you generally approve of Mr. Barlow's proposals as given in his report ?—Generally I do approve of them.

2. *Q.* We have been in Bundelkhand and the opinion we formed there was that the Betwa Canal did its work extremely well, considering the amount of water in it; the only misfortune was that there was not far more water. We also noted that it was practically closed during the rains; but that if the *Bundelas* in its vicinity could be induced to grow rice, there would be a large amount of water available for that crop. In a demi-official letter which I have sent to the Lieutenant-Governor we have said that it would be a good plan to establish an experimental farm there with a view to introduce rice. Do you agree with that ?—I am not hopeful that rice will succeed, but I think it is worth the experiment.

3. *Q.* Why are you not hopeful ?—You heard the evidence of the zilladar; he said that the people had never begun rice there; whether this is due to the constitution of the people or the character of the soil is not

Mr. H. Marsh.

clear. Colonel Corbett, who was a friend of the cultivators got seed and tried to sow rice, but it came to nothing.

4. *Q.* Do you see any chance of employing water in the rains?—No. Extra storage is the first thing I should press for; I have been doing what I can in this direction, but with my limited establishment I am rather handicapped.

5. *Q.* The Ken Canal project is with the Government of India?—Yes.

6. *Q.* Do you know how it is getting on?—We are utterly blocked by the Agent to the Governor-General in Central India; he has not given his consent to it and the Government of India say they cannot go on without his consent. I have written to Mr. Preston demi-officially on the subject.

7. *Q.* (*Sir Thomas Higham.*)—*Apropos* of that, the alignment of the upper portion has not been finally fixed; it will depend greatly on the trial pits?—Yes.

8. *Q.* (*The President.*)—What is the state of the Dassan project?—A preliminary reconnaissance was made. I have not got a party to put on the project at present and am letting it lie over till there are more men.

9. *Q.* You could not have the Ken and Dassan going on side by side; you have not the labour; have you?—I think labour will have to be introduced to carry on these projects.

10. *Q.* Are you favourably impressed with the Belan project as far as you have got with it?—Yes, it is a rice country and wherever there is rice irrigation is of great use, the idea is that a rice country is always poor in the north-west.

11. *Q.* What about the Tons?—It is hopeless, I think; the only thing is that it would be a very useful scheme to have ready for famine; we would have something to show for 20 to 30 lakhs of rupees; they spent that sum in the last famine and have nothing to show for it.

12. *Q.* But if there was the possibility of storage in the upper waters?—The supply in the Tons is not bad, but the command is bad.

13. *Q.* I think you are of opinion, that the Sardah is a project that it is not expedient to carry out?—I think there are very fair grounds for going on with the inundation canal for Hardoi and Shahjehanpur to replenish the natural reservoirs when they fail.

14. *Q.* Would it be available for Shahjehanpur?—Yes, the officer I have sent has orders to see to it.

15. *Q.* (*Sir Thomas Higham.*)—Have you got gauge records at Bambassa on the Sardah?—No.

16. *Q.* Supposing there was a partial failure of the rains before September, would you open the canal?—This country suffers as much from excess of floods as from drought, and it would be rather dangerous to begin before September, as the rain might fall and the canal do damage. I don't think there should be any difficulty about getting in water. The word "inundation" canal is a misnomer.

17. *Q.* (*The President.*)—Are any improvements in progress in Rohilkhand?—Yes, in Rohilkhand there are a number of streams and a very clumsy form of irrigation with earthen *bunds;* we have been progressing there with masonry dams; this year we have had sanction for two projects costing about 3 lakhs altogether. Mr. Bull says he can make a *pakka bund* in the Kho river and is making a survey of it at present; that will make a great difference; with earthen *bunds* we lose the early rice, as the *bunds* are always swept away in the floods.

18. *Q.* (*The President.*)—Is there much water in the Kho river?—There is a lot for the rice country; they have done 17,000 acres of *rabi* with it.

19. *Q.* Is extension possible?—Extension is not so necessary as to make irrigation perfectly safe. 17,000 acres of irrigation in the district are very useful.

20. *Q.* One would like to double that if one could?—Yes, no doubt. It might be possible to do more by going up the rivers.

21. *Q.* The Ramganga water does nothing?—No; it is one of those giant rivers that it would be very expensive to tackle, and you would get an uncertain return from it?

22. *Q.* (*Mr. Muir-Mackenzie.*)—Why uncertain?—It has an immense volume of water when you don't require it and none when you do; it is not a snow-fed river; the river I speak of borders on Bijnor.

23. *Q.* (*Sir Thomas Higham.*)—Have they suffered from floods along the line of the proposed inundation canal from the Sardah?—We shan't know anything about that till the officer on duty there brings in his report.

24. *Q.* Mr. King says you cannot drain Oudh on account of flooding Jaunpur?—There has been trouble in Jaunpur from floods. I am always very doubtful whether drainage increases floods; the effect of drainage is that it gets rid of surplus water between each storm of rain. The worst floods are caused in undrained countries, because the natural depressions are full when a heavy fall of rain occurs. Most of the mischief from floods has come from the cyclone in August and September falling on undrained swamps.

25. *Q.* Are there any gauges at Jaunpur?—Yes. There was a regular inquiry two or three years ago when the Buildings and Roads Branch put special officers, Mr. Parsanah and Mr. Gale, to report about it. Mr. Odling reviewed the report.

26. *Q.* Have you gone into the question of the Ramganga project?—Very slightly; I don't know much about it.

27. *Q.* One reason for hanging that up was that the supply in the Ganges would not be sufficient; that is, for the Eastern Ganges; that difficulty would not occur in the case of a canal from the Ramganga?—I think it would; it is not a snow-fed river.

28. *Q.* There is plenty of water in the river?—No, I may be wrong, but my idea is that it is one of those rivers that has a big flood in the rains and would require expensive head-works, and that it falls to a very small ebb in the cold weather.

29. *Q.* Are there any records?—There must be old ones. There was a great turn in 1869 for utilizing these rivers and gauges were maintained. I dare say we could get something out of them.

30. *Q.* There has been nothing done since 1869?—I don't think so. Lord Mayo was keen about these projects, but Lord Northbrook, I believe, stopped them; he decided to have only paying canals.

31. *Q.* Are there any gauges kept on these rivers?—Not now.

32. *Q.* In Moradabad?—My Department does not keep them; I doubt if the Roads and Buildings Branch do. We have gauges on the Ken, Karamnassa, Tons and Belan only.

33. *Q.* Supposing the Ken Canal is sanctioned, you won't be able to take up the other projects, the Dassan, Belan and Tons?—I gather Government are making special efforts to recruit staff; if we have sufficient staff, we can do them.

34. *Q.* But as matters stand?—In 17 divisions and 45 sub-divisions I have only 6 Imperial Assistant Engineers; 2 just joined and 2 European Roorkee men.

35. *Q.* What is your cadre?—Fifty-four, I think.

36. *Q.* Are there any further extensions proposed for the Ganges Canal?—Yes, minors are to be made and new distributaries.

37. *Q.* Mr. Ivens said yesterday, as regards West Aligarh, that there was not enough water; do you agree?—No, I don't follow him there.

38. *Q.* Do you think the tract is one that requires irrigation?—It requires irrigation, but there is a good deal of bad soil, and I am not prepared to say that it is worth it.

39. *Q.* It it is worth it, do you think you could get water for it?—I think so. We have too much water generally in October and November; in December it begins to get scarce and is worse in January if there are no winter rains.

40. *Q.* You have plenty of water in October for extensions, but would you have water to mature all the crops you could give water to them?—We must reckon on the chance of good rain about Christmas. Agriculture all over the world depends on the weather; we cannot make irrigation so certain as to protect the crops if there is no rainfall. On the Eastern Jumna Canal we had 180,000 acres on hand and the discharge fell to 500 cubic feet; some of the fields were saved by dampness; others were a poor class of crop that required only one watering.

41. *Q.* When do you remit the water-rate?—When the crop is under 25 per cent.

42. *Q.* Which was your maximum year on the Eastern Jumna?—Last year.

43. *Q.* You didn't remit much then?—Very little.

41. *Q* (*Mr. Muir-Mackenzie.*)—In 1896-97 did you give large remissions?—There were some.

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45. *Q.* Have you any experience of a year in which the winter rains completely failed?—Last year was the worst we have ever had.

46. *Q.* (*Sir Thomas Higham.*)—Would it be possible to run an inundation canal from the Eastern Ganges?—Yes, I think so.

47. *Q.* Where would it take off?—Just below Hardwar.

48. *Q.* Could that be run on temporary head-works?—I think so, by helping it with spurs; there is a very heavy drop in the river.

49. *Q.* It has a sandy bottom?—It has small boulders for some miles below Hardwar.

50. *Q.* When do you begin your *bunds* at Hardwar?—That is a debatable point. In 1896-97, when I was Executive Engineer, I began early in September; this year we did not begin till well into October; the floods were too heavy.

51. *Q.* How long does it take to make them?—It takes a long time to complete them. We keep increasing our discharge daily, as the boulders rise in the cribs. Mr. Nethersole has started an experiment by which he proposes merely to give the cribs proper stability with a basis of boulders and then use a needle dam with the bamboos that grow along the canal bank.

52. *Q.* How much do you spend a year on temporary *bund*?—Rs. 35,000. I think we have the cheapest head-works almost in India.

53. *Q.* You have a *pakka* escape at Mayapur?—Yes, and another at Hardwar.

54. *Q.* (*Mr. Muir-Mackenzie.*)—Are you in favour of the Irrigation Department making any extensions of small tanks in Jhansi and Lalitpur?—I think there is a good deal to be done in that way.

55. *Q.* Would you like to see the country properly surveyed?—Yes.

56. *Q.* With regard to the Sardah Canal, your view is that an inundation scheme should be tried before any final decision is come to?—Yes, I am always in favour of making a scheme tentatively.

57. *Q.* You would not finally condemn the Sardah till that has been tried?—No.

58. *Q.* I see in Oudh, in the districts which would be covered by the Sardah, there is an enormous area of rice cultivation; is the greater part of the area which is irrigated from *jhils* rice?—I don't know Oudh well enough to say.

59. *Q.* If the Sardah Canal were made, would it improve rice very much?—Rice is a very perishable crop, and if you have a supply of water for it, it must be a god-send.

60. *Q.* If water is provided, is there a fair likelihood of its being taken?—I think so.

61. *Q.* Mr. King in his report on the Sardah Canal gets out different set of levels from those of the earlier officer, and the conclusion appears to have been drawn from that that the spring level has risen; do you think that a safe conclusion?—I think that is most unaccountable, because the level should have been extremely low when King's levels were taken.

62. *Q.* When were they taken?—In the cold weather of 1896-97 when every well in the country was working.

63. *Q.* Don't you think the drop in the levels does not take place till the year following a dry year?—No; it decreases very quickly.

64. *Q.* It has been found in other parts of India that sub-soil water was abundant in that year, and that the drought was occasioned not so much by any deficiency in the total rainfall as by its early cessation?—I have had a great deal to do with spring levels and found different statements made with regard to them.

65. *Q.* In order to obtain reliable data you require much more careful observations than these?—Yes.

66. *Q.* (*Mr. Roberts.*)—What are the rules for measuring spring levels?—You require a well that is not used for irrigation and one with a good supply in it and you should measure from fixed marks.

67. *Q.* (*Mr. Muir-Mackenzie.*)—What is necessary is investigation extending over a series of years?—Yes, and a very careful selection of wells.

68. *Q.* In Rohilkhand, if it were possible to get a big canal into the country, would it benefit it very much?—I should not recommend it till the small distributaries were developed.

69. *Q.* Are there considerable parts of Rohilkhand that could never be reached by any system?—I don't think so.

70. *Q.* Mr. Alexander said that there were?—My business has brought me mostly into irrigated tracts; I cannot speak on that point.

71. *Q.* In Moradabad and Budaun?—I know practically nothing about those districts.

72. *Q.* One of Mr. Barlow's proposals is that the Irrigation Department should construct wells and take charge of well irrigation; do you approve of that?—No; I don't think we could tackle wells. We could help with field embankments but not wells.

73. *Q.* Could a well constructed by Government compare in cheapness with one constructed by a rayat?—Cheapness depends on the zamindar who has wood, stone, and other materials, rather than on labour.

74. *Q.* I understand you to say that for the saving of the crop you must depend on the occurrence of the winter rains, but I don't see how that agrees with what you say here in paragraph 11 of your note?—We cannot get a full crop without the help of the rains, though we can get a substantial crop. I was pressed last year to give water in October and November only to such fields as would be sure of a second and third watering. I said the country would rise against it.

75. *Q.* Your refusing to give a supply at that time would not give you a larger supply later?—No.

76. *Q.* There is a suggestion in Mr. Webbe's paper that if you are unable to give a second and third watering, you should make a remission; what do you think of that?—So we do remit if the crop fails.

77. *Q.* That meets the case?—Yes.

78. *Q.* (*Mr. Roberts.*)—Mr. Webbe in his paper complains of the way in which Deputy Magistrates are appointed; what is the system?—He is generally a man who rises from *amin* or zilladar and for long service and distinguished merit becomes a Deputy Magistrate. I think the institution of Deputy Magistrates is perhaps the most wise part of our canal administration. His pay of Rs 200 to Rs. 400 is good enough to keep him from stooping to extortion; he is generally above suspicion.

79. *Q.* Mr. Webbe says in his paper—"Another blot in canal administration is the promotion of Deputy Magistrates from the ranks of zilladars, these in turn being recruited from the overseers and *amins*." That is correct?—Yes.

80. *Q.* He goes on to say as follows:—"Whatever the individual exceptions of sturdy integrity (and there are some) it is most inadvisable that men, who have graduated through the lower grades of office and have either participated in extortion or been necessarily cognizant of the same by fellow subordinates, should be promoted to high office of Magistrates for the trial and decision of cases in which fellow subordinates are prosecutors or accused and the agriculturist the accused or complainants. What guarantee can there possibly be when departmental bias and training are all in the direction of concealment of departmental abuses and when departmental and Magistrate are one and the same." That is his indictment?—I should strongly oppose any change in the present system. The Deputy Magistrate has always been my right-hand man; he is the most trusty native official we have and we always treat him with great respect. The appointment of Deputy Magistrate is the goal our men have in front of them, and it keeps them more straight than anything. This is one of the wisest institutions Government have made.

(*The President.*)—I agree with every word of that.

81. *Q.* (*Sir Thomas Higham.*)—He is called a Deputy Magistrate, but I fancy the actual magisterial and criminal work he does is very small?—It is nothing; he is altogether employed on revenue work. Deputy Magistrates helped in the economy of water which has been effected. They made maps and worked with the greatest integrity and pluck; it was through them that we got rid of the blot of *tatils* and corruption.

82. *Q.* How many criminal cases do they have coming up?—One or two cases every month for each man; in the old days I have known a Deputy Magistrate having 600 to 700 cases. Now he is employed in the distribution of water and checking the measurement of subordinates, etc.

83. *Q.* (*Mr. Muir-Mackenzie.*)—Mr. Webbe says in his paper—"The new system of irrigation with reduced apertures *plus* abolition of *tatils* will contribute still further to reduce subordinate *zulam*: provided (*a*) that tampering

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with and diminishing the water-supply at the head of distributary and falls is prevented; (*b*) that interference with *osras* or sequence of irrigation officially prescribed for the agriculturist from each aperture, or their derangement by chowkidars, zilladars and overseers is suitably punished." Is there anything in that?—No doubt some supervision is required. My staff is not good enough; we want a larger European element in it.

84. *Q.* (*Sir Thomas Higham.*)—Do you prefer to employ European or Native upper subordinates?—I like a Native. If he is a good man, he is put into a sub-division and that is a great prize for him.

85. *Q.* As regards the distribution of water between the Eastern and Western Jumna Canals, you say since the improvements there has been a very much higher duty on the Eastern Jumna Canal than before; what do you do with the water saved?—This has only been going on in the last two years. One use of the water saved is that fields that used only to get water at the tail of the distributary in the beginning of the *fasl* are now as well off as those at the head. Another thing is that we are making minors to carry out water farther afield.

86. *Q.* Are you taking up new villages? Are they being admitted to irrigation?—In a few cases. It was only begun when I went to the Eastern Jumna in 1898. Water will escape now into the Jumna and go to the Agra Canal; this is the chief advantage gained. We have escapes the whole way down into the Jumna and Hindan.

87. *Q.* How much goes from the Eastern Jumna to the Agra Canal?—All the distributaries tail into drains; we have drained the Eastern Jumna thoroughly.

88. *Q.* What becomes of the water?—It is caught in the Hindan and Jumna; the Hindan discharge is improved greatly; it was designed for only 200 cusecs, but now we hardly ever get less than 400 to 500 cusecs through it; this improvement is due to drains and escapes in the Ganges Canal and Eastern Jumna Canal.

89. *Q.* You say the duty in the United Provinces is 100 as compared with 84 in the Punjab; but, on the other side, they take water enormous distances; you have not allowed for that?—I think it is quite clearly explained in the printed note.

90. *Q.* (*Mr. Muir-Mackenzie.*)—As regards the Sardah; in what way will an inundation canal be of use in testing the efficiency of the bigger project?—The moment we fill the *jhils* the people will ask for water for direct irrigation; it is the usual way all big canals begin; the Jumna and Chenab began in this way.

91. *Q.* Will it test this matter of spring levels?—I believe it won't affect spring levels very much if we don't stop well irrigation; if we check well irrigation the spring level will come up at once.

Sir E. Buck, K.C.I.E., late Secretary to the Government of India.

Sir E. Buck.

(*Lucknow, 3rd February 1903.*)

Note for the Irrigation Commission.

[This note is only intended as an indication of the points on which I am prepared to offer evidence.]

There is no subject which came under the consideration of the Department of Revenue and Agriculture (from the date of its first establishment in 1880 till 1897 when I left it) in which I took more personal interest than irrigation. With canal irrigation, however, our Department did not deal directly and it was only when a project was referred to us for note that an opportunity occurred to offer an opinion. Our records include, therefore, no official correspondence but only confidential notes on canal projects.

2. This position never seemed to me to be a right one I have always been of opinion expressed first in my report to the Famine Commissioners as a North-West Provinces officer and subsequently in Departmental notes that a definite programme should have been worked out for all India by the Revenue, Public Works and Finance Departments in consultation on the system in which Forest Working Plans in practice, and Famine Working Plans in theory, are drawn up containing programmes which are to be carried out as finances allow and as occasion requires during a given period of years, subject to annual modifications to be decided by the Departments named in consultation.

3. The Irrigation Commission is practically doing this work now, but measures should, I suggest, be taken for maintaining and developing the programme by making some special representation of the Departments named responsible for its necessary modification in future.

4. The system which, I believe, prevailed in the earlier years after the introduction of decentralization was that each Province arranged for its own irrigation schemes, sending them up when required for Imperial sanction, whereas my contention has been that India should be dealt with as a whole and projects arranged in order of relative merit.

5. I lost no time in putting forward these views when, at the end of 1881, the Revenue and Agricultural Department was first organized. I append to this note the brief chapter of the programme of the Department so far as it was concerned with irrigation which sketches this policy (*vide* Note V, Irrigation Projects). I shortly afterwards, when the Sardah proposals came up, took the opportunity of pressing these views, and I remember that Sir Evelyn Baring (now Lord Cromer) wrote a note which I cannot now find intimating that he quite accepted the principle that the irrigation schemes for India should be dealt with on a commercial basis, in view of the facts that the more irrigation proved profitable the more its development would be encouraged and the more money could be found for new projects.

6. Briefly the views which I urged both in the notes quoted and from time to time in other notes were that in allotting funds for irrigation India should be looked upon as one large estate; that in some Provinces or parts of a Province water was gold; in others silver; and in others lead; that so far as funds were available for irrigation they should first be devoted to those regions in which water was supremely necessary for productive and protective purposes; that in those regions the gold price (easily payable) should be taken; that at present we were demanding only the price of lead; the difference being pocketed by the middlemen who were themselves doing nothing for the land; that if the gold price were taken the profits would be available for other schemes, and that the rapid development of canals and other irrigation works would be encouraged instead of, as was now the case, being discouraged by either financial failure or insignificant returns; that the Sardah project and others like it, whatever merits they might intrinsically possess, were relatively of far less utility than many projects which had been or could be devised for regions where water was a necessity, not a luxury. That history had shown that canals had often been taken where water was least wanted; that any such mistakes should for the future be avoided by the co-operation of Departments—Imperial and Provincial—in laying down the programme of the future—"In the course of a very few years," I wrote "the whole country will be mapped out in accordance with its requirements for irrigation in such a way that the Imperial Government will be continuously kept informed of the tracts to which irrigation may be applied without delay with the best results." I asked that my suggestions might be submitted to the consideration of other Departments concerned.

7. The broad view of the position which I recommended was, so far as I know, never taken up until His Excellency Lord Curzon adopted it in the appointment of the present Commission. The Revenue and Agricultural Department was at any rate never asked to share in the consideration of any general scheme. But still there was work which the Revenue and Agricultural Department could do, from time to time, which might assist towards the development of what I will call the general working plan.

8. A most important factor in, if not the foundation of, a general scheme for the development of irrigation in India must be a knowledge of

(1) the facts connected with irrigation in irrigated lands;

(2) the relative requirement for irrigation in unirrigated land.

The Department had already taken up as the basis of all operations for the improvement of agriculture throughout India the scheme of annual records. In that scheme the field was the unit. The facts and conditions relating to each field were to be annually recorded. From the field to the village was an easy step. The facts and statistics for the fields could be collectively shown for the villages in such a form as to indicate at a glance its agricultural needs and capabilities. A further step was then taken. In view of the fact that the executive administration under which the scheme was to be carried out required the records of a group

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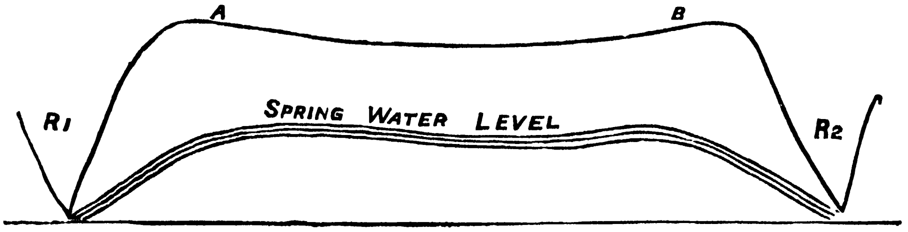
or circle of villages to be supervised by a special official (called the circle officer); the 'circle' could for purposes of investigation be taken as the unit. The system is described in paragraph V of Resolution III, 20th March 1897, in which it was written that " half an hour's examination of the circle book would ascertain the cause of failure in any village or group of villages and enable a remedy to be suggested." Of course a frequent cause of failure would be defects in irrigation.

9. What I desire to point out now is that there is no reason why the Agricultural Departments, who are also the provincial supervisors of land records, should not be able to supply a complete analysis of each Province in regard to the relative need of each and every tract in it for irrigation. While I was in the Imperial Department our time was taken up in launching and developing the system of circle books. We could not then ask for results. But results should be forthcoming now, and if in some Provinces they cannot yet be given, still it should be made a part of the general working plan that the analysis of irrigation, as we may call it, should sooner or later be accomplished.

10. I will give as an illustration of the need of such an analysis the condition of things in a typical belt of land between two of the river feeders of the Ganges in the North-West Provinces Doab. The vertical section of the sub-soil water table in such belts which are very numerous has been found (by taking well depths) to be somewhat as indicated in this diagram—



R_1 and R_2 are the two rivers, say 10 miles apart. Between A and B the soil is consistent and slightly depressed in the centre where *jhils* form in the rains. The slopes (much exaggerated in the diagram) to the rivers are generally sandy or loose soil. Between A and B earthen wells can, as a rule, be generally sunk. Between A and R_1 or B and R_2 the sub-soil is top loose. But a most important point is that the sub-soil water is nearer the surface towards the centre of A B than towards the rivers.

11. Sir Charles Elliot recorded this feature of the Doab tracts in a settlement report on one of the Farrukhabad parganas (giving a diagram). I confirmed it in two belts further south-east.*

* *cf* Mr. Evans' note on Doab tracts quoted on page 6 of my answers to Famine Commissioners.

12. Now when the Ganges Canal was constructed its distributaries were generally led (diagonally) along the strip between A and B, thus replacing wells which already existed, besides in many tracts blocking by a diagonal course the drainage of the central *jhil* system. We had indeed in some tracts to appeal to the canal officers to have the distributaries realigned. But through it all the strips R_1 A and R_2 B got no irrigation at all. The sub-soil was too loose for earthen wells and the surface soil too loose for canal distributaries.* The result is that throughout many of the Doab districts we have the phenomenon of villages starving in a year of drought alongside villages amassing wealth. I have seen a poor village buying cart-loads of fodder at famine prices from a village 20 miles away which was flourishing on those same prices. Sometimes indeed one-half of a village will be starved, while the other half, occupied by a different set of tenants, will, because irrigated, be flourishing. This illustration serves to show that an area of country must be carefully analysed before the need of its different sections for irrigation can be understood. In the Doab, for instance, we have a large number of strips of the A B type, many of which have been doubly irrigated by canal and well, while the parallel strips of the R_1 A and R_1 B type are really in need of irrigation. Any general return would show a fairly high percentage of irrigation in the whole area, and would obscure the deficiency in the dry strips.

* *cf.* Mr. Evans' note quoted above.

13. Now, as a matter of fact, the dry strips yield excellent crops when they (as some few parts of them do) receive irrigation from wells in those sections of them that are level. Unfortunately the unchecked drainage of them to the small rivers is continually eating away the level portions of them. Two protective remedies are required. Firstly, masonry wells; secondly, a system of terracing and damming. In some few cases a specially industrious cultivating community *has* adopted the plan of terracing. It may be pointed out in this connection that the damming of ravines and tenacity of slopes tends to raise the level of the sub-soil water table and thus to facilitate the irrigation from wells.

14. I have indicated that the circle book system of providing an analysis of villages or groups of villages ought to lead to a complete knowledge of the needs of each tract however small. I will now show how the same machinery which provides the facts and statistics for the circle books can be utilized to supply a complete knowledge of the drainage system of the surface of every district in India in which cadastral maps (the basis of the land records) have been prepared. Almost the only exceptions are now the majority of permanently-settled districts in Lower Bengal which need little remedial action and the permanently-settled districts of Madras.

15. In 1869-70 I superintended the assessment operations in the Tirwa tahsil of the Farrukhabad district. Before I proceeded to a village it was the duty of the village officer to record on each field in the map symbols representing its irrigation rate of rent, local name of soil, and so on. I soon ascertained that the key to the distribution of soil was the drainage system. I therefore required the village officer to ask each cultivator as he came to his field in what direction the rain water flowed and to mark this on the map with an arrow. The process cost nothing. A survey official (on Rs. 20 a month) had then to take up the map and divide it into soil circles and so on and in addition to draw in strong coloured pencil the main drainage lines which the arrows easily indicated. In this way we obtained an accurate map first of the drainage of a village, then of a circle, then of a tahsil or administrative section of a district.

16. The survey of the district of Cawnpore to which I was proceeding after Farrukhabad was just then being begun in preparation for me. I asked Mr. Wright, C.S., who was superintending the survey to carry out the system which he did for the whole district and the result is shown, on small scale, in the series of maps of Cawnpore tahsils in the settlement report, of which a copy † is put up. A further use to which these maps were put was that of illustrating how the distribution of saline efflorescence (*reh*) is connected with surface drainage and the maps following page 13 of my report on *reh* are worth studying, as No. 2 shows how easy it is to separate on them the drainage catch basins from areas that do not hold drainage.

† See map in *reh* report which gives one example.

17. The Chief Engineer in the Irrigation Department of the North-West Provinces told me that these maps (on the large scale) was more useful than any professional level maps for laying out canal distributaries, and Colonel Clibburn, who was under me as Agricultural Engineer at Cawnpore, himself carried out the plan in other districts, and in his work on canal engineering published two years ago recommended it for general adoption. Sir Walter Lawrence, whom I also had the opportunity of advising, adopted it in Kashmir.

18. But I would not, as Colonel Clibburn indicates in his book, leave the plan to be adopted merely when a distributary is projected. I would recommend that the village officer be taught how to mark the drainage of their fields and villages and that complete maps should be deduced from the village maps showing the drainage system of every administrative circle in India excepting those few where there are no cadastral maps. It would be done within two years if not one. I have thus shown how the organization effected by our Department has prepared the way of a complete analysis of the need of each agricultural tract for irrigation.

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19. Two other steps were taken. The second was to prove the fact which seemed to be generally ignored that canal water was, in the tracts, let us say, of gold and silver, being sold at the price of lead. And not only so but that the cheap price at which it was sold led both to agricultural degradation and to a want of appreciation of the true value of irrigation. These questions are so fully dealt with in my summary on canal administration (No. XXX) that I need add nothing here.

20. The third step taken was to preach the doctrine of checking surface drainage by dams and terraces.

21. I had taken practical interest in this question when Director of the Department of Agriculture and Land Records in the North-West Provinces and had begun experiments on a small scale on the Cawnpore farm. I was led to the appreciation of its importance by the success of an English landowner whose experiments are described in No. 16, Agricultural Ledger, 1894, but I was taken from the North-West Provinces before my own experiments were concluded. I may mention, however, that Colonel Pitcher, who was under me in the North-West Provinces and had in 1869 taken up the subject (*vide* note, page 2, Proceedings Nos. 74 to 76 of 1887) acquired a further interest in the question at Cawnpore, and when I procured his transfer to Gwalior, was able (as the Commission is aware) to give practical effect to the system on a very large scale in that State.

22. I am not dealing with the subject referring to the larger and more important irrigation works concerned with the formation of water reservoirs and lakes by damming up the rocks of valleys and so on. I only allude to the system of terracing with the assistance of low dams. The essential difference between the two systems is that the former is more concerned with damming up water at its final point of outflow and the latter with checking drainage at its initial point of outflow.

Proceedings Nos. 74 to 76, November 1887.

23. The Department assisted and encouraged an experiment taken up by Mr. Ward, the Commissioner of Jhansi, and the notes in this case, of which the proceedings are appended, may be read as indicating the policy advocated of prosecuting the system on a large scale in connection with famine works. There is reason to believe that the Jhansi experiments were not conducted with sufficient continuity to ensure success, but however this may be occasion was taken in issuing a draft Famine Code to the Provinces, and specially in the case of the North-West Provinces to commend this class of work as specially adapted for famine labour. But as will be observed in the note by myself to Mr. Benett, dated 27th June 1887, it was foreseen that no success was expected "unless plans should be drawn up and a system determined by experiment in anticipation of a famine year, so that gangs might be drafted off to such places as might be considered worth taking in hand without any of the delay or risk of wasted labour which would occur if schemes were not ready."

24. If now the Irrigation Commissioners should consider it desirable that attention should be given to this class of work (as I understand from Mr. Muir-Mackenzie is not unlikely), I venture to suggest that the construction of a "working plan," as in the case of forests, should be set on foot, under the superintendence of a well selected civilian and a first class engineer, in any Province in which local conditions justify prospects of success; that the drainage maps which I have shown can be supplied at very low cost should be the basis of the working plan; that the schemes should (in the case of the North-West Provinces at least) be applied to the slopes towards the small as well as towards the large rivers; and that until a drought occurs experimental action should be carefully taken in selected sample tracts, leaving general action to be taken in a famine year.

25. In view of the fact that damming and terracing tends to raise the level of the water table and to facilitate irrigation by wells the work is one which has a close connection with irrigation.

26. To return to the work of the Revenue Department. Besides the advantages indicated in the preceding paragraph there is the further advantage, which I believe is sufficiently illustrated by Colonel Pitcher's works in Gwalior, that the held up water of the rains fertilizes the surface soil. Thus while sloping land tends to continual deterioration, so level land especially in this country tends to continual improvement.

27. I say specially in this country because, except in abnormally rainy sections of it, there seems reason to believe that the amount of manure washed out of the air by the first falls in the rainy season is far in excess of that washed down in European countries. But while pains have been taken to analyse the contents of a cubic foot of air at different seasons in Europe, nothing has been done towards such an analysis in India. I have more than once urged that this should be done, in order to prove the advantage of conserving the water of the first rainfalls of the summer.

28. Whatever may be the case elsewhere there seems *primâ facie* reason for presuming that the atmosphere over the North-West Provinces and Oudh and especially in the south-eastern tracts must contain an exceptional quantity of manurial elements in a useful form. The conditions are these. The face of the country is covered by the daily droppings of some 50 millions, say, of human beings, and of a larger number of cattle which lie exposed to the sun and air for a period of five or six months. The greater portion of the cattle dung is, it is true, dried for fuel, but the scrapings remain while the ashes, and, during the four months of the rains, the dung, are conserved for manure which is spread over fields at a shallow depth in October. In April a daily dry wind begins to blow which increases in heat and strength until just before the rains. It does not blow at night and, what is important, the winds do not carry much beyond the borders of the North-West Provinces. The manurial elements, whatever they are, are hung therefore over the land, as indeed is indicated by the thickness of the haze in May and June, and must be brought down by the first heavy rain.

29. Two years ago I suggested to Mr. Mollison (the Imperial Agricultural Officer) that he should take up this question and he may probably have done so. It would be interesting to know what is the value of the rain-water which has to be conserved at each season of the year, and I may add in this connection that no one who has camped out in the North-West Provinces in May can disbelieve in the power of the wind to distribute surface dust, for in the neighbourhood of a *reh* plain the air is as if filled with snow which is blown over cultivated land but much retained in the air. Fortunately, as America has proved, *reh* if not in excess is a useful manure, and I could specially point to Sir C. Crosthwaite's note on the extraordinary fertility of lands near the plains of excess *reh* which will be found in the *reh* report.

30. I will not go further into this subject, but will pass to a cognate question, which concerns the utilization of water of drainage courses, rivers and streams which is supplied by the earlier falls of rain in the higher lands. My attention was first drawn to this subject by Sir Colin Scott-Moncrieff's work on "irrigation in Southern Europe." In 1893 I circulated an extract from this work (*vide* Agricultural Ledger No. I of 1893; also page 3, Agricultural Ledger No. II of 1897, quoting the 1893 circular). Information was called for from every Province as to action taken or practice prevailing in connection with dams and *bunds* with special reference to the fertilization of land by deposit of soil. Some of the replies are very interesting and suggestive and have doubtless been read by the Irrigation Commission. They indicate that in some of the sub-Himalayan districts the practice does prevail of utilizing water descending from the hills during the rains.

31. In the absence of any funds or executive subordinates the Revenue Department could do little more than to draw attention to the subject and to direct its discussion at the Agricultural Conferences of 1893 and 1895 at Simla. The only positive action which was taken was to instruct the Agricultural Chemist to carry out a small experiment at Dehra where it was thought that the canal distributaries would give facilities to a fair trial of the value of the flood deposit. But owing perhaps to the fact that he was new to the country and had insufficient engineering assistance, the experiment was not carried out. But it is one that, now an Imperial Director of Agriculture has been appointed, can be instituted with some chance of success.

32. The most important point to which, in my opinion, attention should be given, at any rate in the initial stage of experiment, is to ascertain the fertilizing value of descending water at different periods. This may be done in two ways—

(1) by analysing the water and its deposits in the laboratory;

(2) by testing its practical value in the field.

33. I believe it will be found that as in the case of rainfall the valuable water will be found to be that supplied by the earlier river floods of the rainy season. It is reasonable to presume that the humus and decayed vegetation which is washed down drainage courses by the first weeks of heavy rainfall supply fertilizing water which is not contained in the water flowing down those courses when they have so to speak been once cleaned, and when the loose surface deposit

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in the catch basin from which they are fed has been already removed by the early floods.

34. It is indeed the case that the Canal Departments have from time to time tried the effect of silt deposited by canal water, but it may be doubted whether attention was given to the special capture of that water which was likely to bring fertilizing matter. At any rate the result of those experiments which were brought to my notice was that the silt was not fertilizing. This result was also due to the circumstance that the canal water flowing rapidly through well defined beds secured sand from the sides of the channels

35. What seems to be required is that the water should be brought to the area to be flooded at a slower flow than that which obtains in our larger canals. However this is a question with which I am not competent to deal. I can only urge that the problem should be taken up by our agricultural and engineering experts, and that it should be definitely decided in all localities which offer facilities for arresting descending water and utilizing its deposits—(1) what is the value of its fertilizing matter at different seasons and especially in the earlier floods ; (2) whether the deposits can be profitably utilized.

36. I suggested to the Agricultural Director (Mr. Mollison) two years ago that the question should be worked out, and I believe he has taken measures for the analysis of the water. But the experiments should be carried out with the assistance of expert engineers on a sufficiently large scale to set the question at rest.

37. An important issue which the subject raises in connection with irrigation is the effect which the system of arresting drainage flow has on the sub-soil water level. I believe that in Colonel Pitcher's low dam system in Gwalior it has been found that though the drainage comes from small catch basins in hills covered with scanty vegetation, the fertility of land covered by the arrested water is improved partly by the deposits and partly by the increased moisture below the surface. The results which would be obtained by arresting the Himalayan and other mountain drainage ought to be much more important in both directions, and it seems possible that, if attention is directed to the earlier flood waters only, the fertilizing matter might be carried down for deposit on agricultural lands at a considerable distance from the mountain ranges through the system of canals and minor distributaries which already exist. At present there can be little doubt that vast quantities of fertilizing matter are carried down by the main canals in the rains from the heads of such rivers as the Ganges and Jumna and are poured into those rivers again either at the junction with them of the tail of the canal or by escape channels.

38. The only other point to which I would draw attention now is the harm done to agricultural land by the facilities given for flush irrigation from canals. The water in the irrigating season is probably free of fertilizing matter and by over-flooding exhausts the land prematurely. This evil is shown in my note on canal irrigation to be enormously enhanced by the unduly low rates which are paid for canal water and which tempt the cultivators to pour water in unlimited quantity over poor land which is further impoverished by the excess drenching which is received When I accompanied the Famine Commissioners in their tour in the North-West Provinces this view was strongly urged by a very intelligent English planter whose estates were irrigated by canal, and I have found this opinion to obtain among many other intelligent agriculturists. I am strongly inclined to the belief that in all working plans for irrigation in the future a slight 'lift' should be preferred to flush irrigation. If water is 'gold' it should be economized. A system of nothing but flush irrigation, besides doing harm to much of the land watered, restricts the supply which could be carried to other tracts which need it.

39. I will supplement this note later on by a summary of the suggestion which it contains.

The points on which I make suggestions are—

(1) that there should be a working plan (as in forest administration) drawn up for all India and each Province. This is being done by the Irrigation Commission ;

(2) that the principles in which the working plan is based should be clearly enunciated ;

(3) that one principle should be to accord funds to schemes in order of relative merit, instead of allowing each Province to take up its own schemes, many of which may be relatively inferior or, as I once wrote, take water first where it is *gold*, then where it is *silver*, then where it is *lead* ;

(4) that some controlling authority—Imperial and Provincial—must succeed the Commission to secure the development of the working plans and executive action ;

(5) that (as in the case of forests) no material modification of the working plans should be allowed except with the sanction of that authority ;

(6) that an analysis, with respect to its need for irrigation or treatment of drainage, should be made for every agricultural tract in India on the system described in the third of our 1897 Resolutions. This could be done in two years ;

(7) that a drainage map of all agricultural tracts in India which have been cadastrally surveyed should be made. This could be done on the system on which drainage maps were made for the Cawnpore district at little or no cost in two years ;

(8) that the controlling authority of (4) above should arrange for a working plan for each tract for which the Irrigation Commission has not prescribed ;

(9) that an analysis should be maintained of the fertilizing value—

(1) of the early rain which brings down much fertilizing matter from the atmosphere and should be therefore conserved ;

(2) of the early floods which bring much fertilizing matter from the high lands ;

(10) that the treatment of tracts, of which soil is washed away by drainage, by systems of dams and *bunds* should be carefully prescribed ;

(11) that the physical conditions of belts between small rivers in the Doab (first described by Sir Charles Elliot) should be examined as an illustration of the need of dealing with many small tracts separately ;

(12) that wherever circumstances admit, a map of the sub-soil water table should be made (as in Sir Charles Elliot's illustrations) ;

(13) that canal water should be sold at as early as conditions admit its full commercial value ;

(14) that a short lift is better than flush irrigation ;

(15) that cheap flush irrigation is harmful to agricultural interests

(16) that with reference to (9) above canal distributaries should be used for depositing fertilizing matter on agricultural lands in the earlier days or weeks of the rainy season.

Sufficiently discussed in my note on Canal Irrigation.

(*The President.*)—The first point taken up in your memorandum is that of working plans. Would you deal with each Province separately and have a working plan for each?

(*Sir Edward Buck.*)—India, I think, should be treated as a whole. You might wish to give nothing to some Provinces.

(*The President.*)—The converse would be to allot a certain amount to each Province to use as it likes?

(*Sir Edward Buck.*)—I would condemn that.

(*The President.*)—Dealing with India as a whole your allotments might go beyond the labour market in some Provinces?

(*Sir Edward Buck.*)—That would be a matter of detail. The scheme must be modified to suit local conditions.

(*The President.*)—The second point is that of control. Should not that rest with the Inspector-General of Irrigation?

(*Sir Edward Buck.*)—Would he take wells, etc., under his control?

(*Sir Thomas Higham.*)—Sir Edward means not to have all in the hands of one man.

(*Sir Edward Buck.*)—I mean that in my experience of administration in India the recommendations of many

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Commissions have been simply laid on the shelf. I will give one instance. The Famine Commission's recommendations would not have been carried out unless followed by the institution of a special department to see that they were carried out. If the report had been left without a controlling authority to see that the Commission's recommendations were carried out, very little would have been done. The Agricultural Department was created in 1880 with the direct object of seeing that the recommendations were carried out. We got the various Provinces to accept the principles, not by putting the recommendations before them, but by going round and discussing with local authorities and holding agricultural conferences. I refused to take up my appointment unless allowed to travel and consult local authorities. Working plans were carried out. I spent two years on special duty and developed a revised working plan made out in consultation with the local authorities. This was published in 1897, and stated the principles which had been agreed to with the local authorities, but since then the Provinces have been left to themselves and have not done what they agreed to do. For instance, they agreed to appoint agricultural experts in each Province. To this day the Punjab has not got one, nor Bengal. Your Commission won't succeed in attaining its object if the Provinces are left to themselves to carry out your recommendations.

(*The President.*)—Has the Agricultural Department given up the supervision of work since 1897?

(*Sir Edward Buck.*)—The Secretary has so much work to do that he can only deal with the records before him. If the Commission's recommendations are to be carried out, there must be a controlling authority to develop their working plans. You can scarcely have had time to draw up a working plan in all its details. The system works splendidly in the Forests. There is a definite working plan which has got to be carried out some time or other. No modification is allowed without the consent of the central authority and there is a Board of three members, each Province in turn sending a member, the Inspector-General being *ex-officio* member.

(*Mr. Muir-Mackenzie.*)—You would have the same supervision as regards wells, etc.?

(*Sir Edward Buck.*)—Exactly.

(*The President.*)—The Board would settle the grant to be made to each Province

(*Sir Edward Buck.*)—It would occupy the same relation to your Commission that our department did to the Famine Commission. We had no control over funds, but made recommendations. For instance, the Famine Commission recommended the formation of a Veterinary Department. There were no funds to admit of this being done for some time, but the recommendation was carried out eventually, we making certain modifications as we had more time than the Commission to go into details.

(*Mr. Mudaliar.*)—The Inspector-General might have annual conferences with the revenue officers. To revert to the first point, if funds were given out in order of urgency, the Punjab might get none for many years?

(*Sir Edward Buck.*)—As an illustration of my meaning I would refer to the Sardah canal where water would only be required in years of famine.

(*Sir Thomas Higham.*)—Many other considerations come in. Canals in the Punjab may not protect against famine, but may give enormous return on your money?

(*Sir Edward Buck.*)—The need for protection is one merit; the price you get for water is another merit. When you come to consider the money spent on canals you will find that much has been spent where water was not really needed—in Orissa for instance.

(*The President.*)—To go on now to sixth point. You say "A most important factor in, if not the foundation of, a general scheme for the development of irrigation in India must be a knowledge of—

(1) the facts connected with irrigation in irrigated lands;

(2) the relative requirement for irrigation in unirrigated land.

(*Sir Edward Buck.*)—The Department has already taken up as the basis of all operations for the improvement of agriculture throughout India the scheme of annual records. In that scheme the field was the unit. The facts and conditions relating to each field were to be annually recorded. From the field to the village was an easy step. The facts and statistics for the fields could be collectively shown for the villages in such a form as to indicate at a glance its agricultural needs and capabilities. A further step was then taken. In view of the fact that the executive administration under which the scheme was to be carried out required the records of a group or circle of villages to be supervised by a special official (called the circle officer), the 'circle' could for purposes of investigation be taken as the unit. The system is described in paragraph V of Resolution III, 20th March 1897, in which it was written that "half an hour's examination of the circle book would ascertain the cause of failure in any village or group of villages and enable a remedy to be suggested." Of course a frequent cause of failure would be defects in irrigation.

(*Mr. Muir-Mackenzie.*)—In Bombay I doubt if you could find information about irrigation from any of our circle books. There ought to be remarks made as to possible sites of tanks, etc.?

(*Sir Edward Buck.*)—It should be the duty of the controlling authority to see that information of that kind is recorded. If it is decided that the circle book is the place to record the needs of irrigation you must provide a controlling authority to consider those needs and the possible ways of meeting them. A good Collector finds a circle book so useful that he does see that the books are kept up. When a village is found to be in a bad way the analyses as regards irrigation are more easily made than any others owing to its being a permanent defect. When I was in Cawnpore not long ago as an experiment I called up the books of one circle and it took me just half an hour to ascertain what villages had declined and to ascertain the cause.

(*Sir Thomas Higham.*)—But if you have a large scheme you do not want to know the conditions of particular villages?

(*Sir Edward Buck.*)—I think you do.

(*Sir Thomas Higham.*)—Could not the District Officer tell you all you want to know?

(*Sir Edward Buck.*)—No; he would not have the information without the circle books.

(*Sir Thomas Higham.*)—You might want to give some villages a step up even though they were not going down?

(*Sir Edward Buck.*)—I think that the best illustration of the necessity for a detailed examination is given in my note.

(*Sir Thomas Higham.*)—For a large contract would you depend on the circle book?

(*Sir Edward Buck.*)—Not perhaps for a general scheme, but when you come to distribute water from a main channel. This is exemplified by the canals in the United Provinces. (*To Sir Thomas Higham.*)—When I said that the District Officer would not have the information I meant that he would not unless he had a circle book, for with it his knowledge is very perfect. I put my eleventh point forward as showing the necessity for a detailed analysis of each village and arranging for the distribution of water. But the circle book can only be utilized for a working plan where you have a cadastral survey. Eastern Bengal occupies the chief area where you have not a cadastral map, and there the needs for irrigation are not pressing. The circle books will give an analysis without any cost of the irrigation needs in places where they have got a cadastral map.

(*The President.*)—To go on to the seventh point, drainage maps.

(*Sir Edward Buck.*)—These maps are required not only for canal irrigated tracts, but for all questions connected with dams, *bunds*, drains, etc. They would be especially useful in the Central Provinces where the system of field embankments is so much in vogue. In Cawnpore four men on Rs. 20 a month supervised the preparation of the maps and did the whole district. They did four villages every morning and other work at the same time, analysing rents, soils, etc. Besides a drainage map gives a key to the distribution of the soils which at first sight is apparently unintelligible.

(*Mr. Muir-Mackenzie.*)—In Bombay we have position classes of soils. Soils lower down pay an anna or two more than those at the top of the drainage land.

(*Sir Edward Buck*)—It is a general rule that soils higher up the drainage lands are lighter than those lower down. I have also advocated investigations into the value of early flood water. No investigations have yet been made to show how much better this water is than that of the later floods, nor have any steps been taken to use the water for fertilising fields. The cultivators have taken action in a few places, but the administrators of the country have done nothing.

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(*The President.*)—What is your opinion as to employing famine labour on the construction of ***bunds*** and field embankments?

(*Sir Edward Buck.*)—We discussed the question at an agricultural conference at Simla, and it was advised that where such works were likely to improve the land they should be included in the famine programme. I have not been able to ascertain if the recommendation or rule as I may call it has been carried out. The sites of such works should be fixed beforehand. No one has been appointed to do this. There should be an authority appointed to see that this work is carried out. If it is to be done there must be a special officer with nothing else to think of. This necessity for a controlling authority is the main point on which I wish to have my evidence considered; and the next most important point is that of detailed surveys on the basis of the circle books and village maps.

Supplementary note by Sir Edward Buck.

In 1878, *i.e.*, towards the end of the great famine of 1876-1878, a Commission was appointed by the Secretary of State under the presidency of Sir James Caird to recommend the measures that might seem to them necessary to protect the country against the consequences of drought.

One of the most important of their recommendations which was carried into effect in 1881 was the creation of a department which should deal with the main portion of the other measures which they advised.

In 1897 a series of Resolutions, drawn up after consultation with, and practically in agreement with the views of, every Local Government was issued, which, while explaining the action which had been taken under the direction of the new department between 1881 and 1897, set forth the scheme which had been framed and was to be maintained with the main object, above noted, of protecting the country against the consequences of drought. The improvement of agriculture entered largely into the scheme, because the increase of the food supply which might result, would tend to relieve famine, but one of the chief questions to be dealt with was of course protection by irrigation.

The new department was not executive and had therefore no funds for initiating or carrying out irrigation schemes. Its main function in this direction was to establish a system by which the need of every agricultural tract for irrigation, or any other remedial or protective measure, could be accurately ascertained.

An attempt to establish such a system had already been made in the North-West Provinces by the only so-called Agricultural Department in India, created by Sir John Strachey, and it was on a recognition of its importance by the Famine Commissioners that I was selected by the Government of India to extend it to other Provinces.

The introduction of the system into the various Provinces took many years to accomplish, and indeed it was only within the last two or three years that Mr. Muir-Mackenzie ensured its introduction into the Bombay Presidency. It has, however, been in working for a sufficient number of years in some Provinces to give assurance of its ultimate success under efficient and effective direction.

The system is so fully explained in the first three of the Resolutions that I need not do more than briefly describe it here. But I would first lay stress upon this point. If it was thought necessary and desirable by the Famine Commissioners, and on their recommendation by the Government of India and the Secretary of State, to establish the machinery which has been created and is now in working with the main object of aiding in the protection of the country against the consequences of drought, it would, I venture to urge, seem desirable that the present Commission, which has the same object in view, should, in any general programme which they may recommend, advise that fullest possible use should be made of the machinery created.

I will not pretend that extensive as the machinery is it has been expanded at great cost, because, in facilitating land settlements, it has, in most Provinces, more than repaid increased outlay, as was proved by the Famine Commission of 1887. On the contrary, I suggest that the very small cost which its utilization demands is one of the strongest arguments in favour of using it.

I take it that there are two classes of country needing irrigation which demand respectively two classes of irrigation schemes, *viz.*, (1) those tracts which can at once, without any very elaborate enquiry, be pronounced to admit of protection, partial or complete, by large irrigation works, such as great river canals, the construction of lakes and important reservoirs by damming, etc., and (2) those which require after elaborate investigation detailed treatment by wells, small canals, the damming of drainage (such as has been effected in Gwalior), or flooding. Even, however, in the case of (1) detailed enquiry is necessary in working out the proper distribution of the water. And it is in all cases in which detailed information is required that the established system may be found useful.

Referring now to the system, explained in the Resolutions, the basis of it is the annual record, each year, of the conditions and circumstances of each field by the village officer. The facts and statistics of the fields are then totalled and ledgered for the village. These, again, are totalled and ledgered for a circle of villages, say 50 or 60, by a circle officer who supervises the village officers of the circle. From the facts and statistics thus recorded a circle book is compiled from which it is easy to detect the progress or decline of every village or group of villages, as well as the special need for protection, relief, or improvement of any kind.

The officers of the district staff are required to periodically examine the books on tour and to note their opinion whether any remedial measures are necessary.

Let us take now the application of this system to irrigation, including in that term any action connected with drainage. It is impossible to expect that, with all their other duties, the district staff can work out any such analysis in detail of the varying agricultural tracts of their district to justify the expenditure of public funds for purposes of protection. What seems required is the co-operation of experts for the investigation. But there is in each Province a Department of Agriculture and Land Records which was specially appointed to work out in co-operation with the district officers what has been termed the "district analysis." If that department be properly strengthened, it could, in a few years, secure a satisfactory exposition (with maps) of the relative and actual need of each tract for protection by irrigation.

Assuming that this measure be carried into effect, it would be necessary that the Provincial Department be strengthened by one or more officers to be made specially responsible for completing the analysis. At least one administrative assistant (a civilian) and one selected engineer would be required. It would depend upon the funds available and the rate of progress demanded how far the staff should be further increased, but in my opinion it would be found that more than one engineer would be wanted.

I may point out, however, that the most important and expensive part of the machinery (the village officers) and circle officers is an already paid agency doing (so far as their expansion for the land record sytsem is concerned) remunerative work. The cost which would be required for the utilisation of their work in the direction of district analysis would form a very small percentage of the cost of the subordinate agency, and it would seem a pity that the information recorded and ledgered by that agency and ready for use should fail to be effectively utilised for want of a little more expenditure.

I will take now one or two illustrations which will indicate the nature of the investigation contemplated. I have in a paper already submitted to the Commission explained how in certain of the Doab districts in the North-West Provinces the tracts that are thoroughly protected by canals and wells are margined by belts which are practically unprotected by canals and wells. I will indicate a district (Etah) in which such tracts were, under the orders of Government, made the subject of a brief inspection by Sir Charles Crosthwaite (Secretary of the Board of Revenue) and myself as Director of the Land Records Department, and were decided to be in certain parts so 'precarious' as to be classed as land which could have no rent. The Meteorological Officer, Mr. Blanford, showed that this district lies in a circle which compared with the Province generally suffers from uncertain rainfall.

We will suppose now that the administrative officer takes up that district for analysis. It would be easy for him in one season to mark off on the map all precarious tracts and to place them in relative order in accordance with their relative need for protection. He would base his analysis on the reports of settlement officers and the annual record in the circle books. He would probably be able to add general information obtained from these sources and from local enquiry indicating whether earthen wells, masonry wells, or canal irrigation was possible. As a rule, owing to the sandy nature of the soil and sub-soil in such tracts, earthen wells and canal distributaries are not possible. The issue would then be raised whether masonry wells, or the damming of drainage would be possible or not. [By 'damming' is here meant some such system as that worked out by Colonel Pitcher at Gwalior, or by Captain Chapman at Beti,* which, specially in the latter case, aims at the levelling of the land and prevention of erosion, and not at the storage of water for irrigation.]

The engineers would then come in. It is assumed that the engineering staff of the Agricultural Department would, independently of the requirements of any local tract, have obtained by experiment sufficient knowledge of the best and most economical system of constructing wells, and would also be able to ascertain by boring or otherwise the character of the sub-soil and the sub-soil water level in each locality, and that they would be able to submit a fairly accurate estimate of the cost of masonry wells and the extent to which they would afford protection. The administrative officer, in consultation with the district officers, could then frame an estimate of the increased produce and rental which might be expected.

The cost of dealing with the drainage, which unchecked is often in such tracts the cause of the poverty and of the increasing deterioration of the soil, might be too great to be justified, but in that case the scheme should nevertheless be placed on record and brought with the sanction of the Government into the list of famine works

Another illustration which may be offered is that of a tract where it may be thought possible to bring a canal distributary. In this case the question should be referred to the canal officers. But I would here point out that such cases would be suggested by the drainage maps which, as explained in the paper already submitted to the Commission, can with a small cost for special instruction and supervision be worked out by the village officers and circle officers. It was done with ease for the whole of the Cawnpore district, and the plan on which it was effected has since been adopted (see Colonel Clibburn's work) for aligning distributaries on new canals. But there are many tracts within possible reach of the old canals and their branches, for which the Canal Department has no such drainage maps, and I suggest that any analysis of a tract needing irrigation would be much facilitated by the provision of such drainage maps which, in the case of Cawnpore, were pronounced by the highest canal authorities to be more useful than the maps showing level by professional survey.

To return now to the question of protection by masonry wells. It has been assumed that the cost of the wells, the extent of the protection they would afford, and the increase of produce and rental which might be expected will be ascertained by the administrative and engineer officers of the department, and that a scheme of protection will be prepared, in consultation with the district officers, for the consideration of higher authorities. It is clear that any such scheme will carry with it many other issues, most of which, however, as affecting all schemes of similar character will have to be decided, independently of the local project by the Local Government.

First, the provision of funds. It has been suggested in my separate paper that gradually a working plan, which would be composed of large projects proposed by the Canal Department and of minor schemes of protection such as those described, should be constructed for the whole province. It would presumably be arranged by the Imperial and Provincial Goverments what funds should be annually available for carrying them out. The supervision of any local scheme would not therefore entail any immediate requisition for a grant, but would only require decision whether or not it should be placed on the provincial working plan. I have already suggested in my separate paper that, as a rule, those schemes should first be taken up which would be most remunerative, and that all projects admitted on the working plan would be placed in relative order of merit, although, for special reasons, that order may be partly determined on other than financial considerations. Assuming that the grant for such works be obtained by loan, it would be desirable that, as far as possible, the interest on the loan should be recovered from the land irrigated, with however some consideration of the indirect benefit from the irrigation works in securing punctual payment of land revenue; in obviating famine works; and in (though perhaps remotely) keeping down prices of food-grains.

Assuming that in a given tract a masonry well rendering irrigable 20 acres of land costs Rs. 500 and that the standard of return on capital is fixed at 4 per cent. this would mean a charge of Re. 1 an acre on the land served by the well. Such a charge ought to be easily recoverable.

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One question to be determined is whether the landlord should be made responsible for recovering the charge, or whether a water-rate should be imposed on the tenant.

Another question is whether the Government should offer the capital as *takavi* to the landlord, or in some cases, to the tenant instead of constructing wells by its own agency. And in the case of *takavi*, how far the Government should help the agriculturist by providing expert assistance or advice, boring apparatus, special brick kilns, and so on.

These issues depend again on the question whether protection by wells is to be forced on a tract where it is proved to be advantageous, or whether the consent of the community is to be obtained. In connection with this question it may be noted that landlords are often averse to devoting their capital to well construction in view of the fact that they can find more profitable investments elsewhere.

Questions will also arise which must be dealt with by the local authority as to the method in which the tenants of land rendered irrigable as to share in the use of the well.

It will perhaps be found that some of these, and similar,* issues were discussed in proposals for legislation in connection with well irrigation some 20 years ago and probably the same questions may have been brought under the consideration of the Irrigation Commission. I am not in a position to deal further with them now. My main object is to indicate that if any measures are to be taken to protect, either by wells or other minor works, those tracts which need irrigation and which cannot be brought within the scope of large irrigation schemes, it will be desirable to base those measures on the analysis of agricultural lands which I have described. This view would seem to hold good whatever be the financial or administrative methods adopted.

I am further of opinion that what I have called the working plan of a province cannot be framed hurriedly or on the basis of existing information. It is true that an initial analysis of tracts needing protection can be effected in a short term of years. But, in view of the fact that no organized measures have been hitherto taken for the proper investigation of the various problems connected with minor irrigation works such as wells and the treatment of drainage, it is impossible to frame sound projects without prolonged enquiry. I contend that such enquiry must be placed in the hands of officials made specially responsible for the work of investigation, and I have indicated that the Agricultural Department should be expanded for the purpose. Probably it might be considered desirable that the Imperial Department should be strengthened with the object of collating information and of ensuring continuity.

Initial measures will naturally be experimental and will demand cautious action. It is a case where knowledge of the subject, *crescit eundo*, and later on progress may be more rapid. It is true that some experiments have been from time to time made by officials in the construction of masonry wells and also in the use of boring apparatus. But they have been desultory and with one or two exceptions conducted by inexperienced agency. So too the questions which relate to the co-operation of landlords and tenants have been theoretically discussed rather than practically dealt with.

The first need then seems to be the establishment of a permanent agency which will be responsible for the continuous examination of each vexed problem, whether it be of financial, administrative, or executive character, with the object of securing its final determination.

That agency should logically be placed under the direction of the Provincial Department of Land Records and Agriculture.

At present the work of the Provincial Department is conducted in close co-operation with district and divisional officers. The rule is that the Departmental officers investigate and suggest and that the administrative officers decide or submit to higher authority. It would seem desirable that the same policy be carried out in the development of minor protective schemes.

I have always, in my own official career, been a strong advocate for Commissions such as the Irrigation Commission which I am addressing. As will be seen from the 1897 Resolutions, I never lost an opportunity of developing the working plans of the various branches of our department by provincial consultations personally conducted. Our series of provincial conferences were of the nature of "Commissions." But I invariably found that unless some authority were established with the responsibility of giving effect to the recommendations of the conferences that their recommendations were simply "put on the shelf." To

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* See Agricultural Ledger on dams where this is described.

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compare great things with small it may be safely said that if the Famine Commission had not been followed by the creation of one special Imperial Department supplemented by that of the Provincial Departments practical effect would never have been given to the major portion of the recommendations of that Commission.

The investigations of the present Commission must result in the formulation of many valuable suggestions, but many of these will, from the absence of sufficient data, be of the nature of problems, for the solution of which prolonged enquiry and experiment will be necessary. It is essential that an expert agency should be established for working them out. And even in those cases where the suggestions or recommendations are final in character and do not demand further enquiry, it is equally necessary that an agency should be established which will be responsible for seeing that effect is given to them.

Now, as already indicated, the agency which would deal with minor protective works will have, under its venue, duties of varying character, which may require to be brought under the control of different authorities.

Firstly.—There is the district analysis, or the classification of tracts, requiring protection by minor works including in that term the extension of distributaries from major works.

This duty can be effected by the Provincial Department duly strengthened on its administrative side in consultation with the local administrative officers.

Secondly.—The consideration of the most appropriate treatment. This, in my opinion, should be mere orders subject to the review and approval of the best expert authority available, just as the projects for canals are subject to the review and decision of the Chief Engineer. How that authority should be constituted is a matter of detail. Possibly in the North-Western Provinces the Board of Revenue or in the Punjab the Financial Commissioner, might have, attached to them an engineer of high rank, on whose advice the Board or Commissioner would sanction the scheme with the approval of the Local Government. I will call him the Provincial Engineer.

Thirdly.—There are the continuous experiments in connection with boring, masonry wells, drainage maps, checking of drainage by dams, flooding, levelling up ravines and so on.

These should manifestly be conducted by the executive branch of the local Agricultural Department, but reported to and inspected and reviewed by the Provincial Engineer.

Fourthly.—There are the problems of administrative and financial character already indicated. These must be attached by the district and divisional officers in co-operation to some extent with the Land Record Department and subject to the higher revenue authorities and the Local Government, who will, as time goes on, be perhaps able to formulate definite rules for guidance.

Fifthly.—There will be executive work of carrying schemes into effect.

It is not assumed that the executive staff attached to the Department of Agriculture for purposes of experiment and enquiry will suffice for this work. Nor is it assumed that such work will be undertaken simultaneously in several districts. Especially at first, as already indicated, the area undertaken should be limited.

What seems desirable is that a special executive staff should be appointed to work under the immediate direction of the departmental engineering staff, and that it should be moved from one area to another or from one district to another in accordance with any working plan that may be developed. The work would be subject to the review and general direction of the Provincial Engineer.

Sixthly.—The results of the investigations, experiments, and executive work in the various Provinces will require collation and publication by Imperial agency just as, to quote a recent example, the educational programmes are reviewed and assisted by a Central Bureau, which however has no power to interfere with Provincial authority and action. One of the useful functions of such central agency is to keep alive attention to the subject in all Provinces; another to convey information of results obtained in each Province to all other Provinces.

As similar central work is required in very many branches of the Imperial Department of Revenue and Agriculture, I would venture to revert to the original intention of the Government of India and Secretary of State to add a second officer to the Imperial Department whose duties should be peripatetic, for the purpose of obtaining accurate knowledge of the various questions dealt with, such as, for instance, the training of agricultural experts, the prevention of cattle disease, the results of agricultural experiment, and so on, as well as, in this case, the results of experiments with wells, checking of drainage and other minor protective works and the methods of distinct analysis.

The whole scheme would require the gradual elaboration of a working plan for each Province; the first step in which or rather the foundation of which, would be the distinct analysis or the classification of tracts needing protection. As time went on the working plan would include the suggested treatment of each tract to be modified subject to the sanction of requisite authority in accordance with the results of continuous experiment and practical experience.

The rate of progress in carrying out the working plan would be determined partly by financial considerations and partly by the conclusions arrived at, as time went on, as to the efficacy of the various methods of treatment suggested or tried. And, as a rule, those tracts would first be dealt with which stand in greatest need of protection or which promise the most remunerative results.

NATIVE STATES.

COLONEL S. S. JACOB, C.I.E., State Engineer, Jaipur.

(Jaipur, 18th November 1901).

Colonel S. S. Jacob.

The following papers accompany this memorandum :—

1. Appendix I.—Statement of areas irrigated annually (paragraph 7).
* 2. Map of the Jaipur State (paragraph 9).
* 3. Printed statement showing nature of each work, capacity and areas, etc. (paragraph 10).
* 4. Diagram showing rainfall. Expenditure on irrigation and revenue realised (paragraph 19).
* 5. and 6. Statements (A) and (B) showing expenditure and revenue in certain tahsils compared (paragraphs 20-21).
* 7. Memorandum on Famine Protective Works (paragraph 33).
* 8 Final Famine Report, 1899-1900 (paragraph 33).

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1. *Geographical position of the Jaipur State.*—The Jaipur State is situated on the watershed of India; part of the drainage runs into the Bay of Bengal, eastward, while immediately on the west border the drainage flows into the Gulf of Cutch. The general slope of the country is from the north towards the south-east. Situated thus on a ridge, with a wide sandy desert northwards, with no perennial streams or mountain ranges to depend upon, it is not to be expected that the same facilities should exist for canals or large projects as are found in more favoured districts.

2. *Necessity for Storage Reservoirs.*—The great object therefore must be to store all the rain that falls on the surface of the country by making storage reservoirs and diverting, where possible, the flood waters of the streams. All water allowed to pass away unused is an *annual* loss to the State.

3. *Wells.*—Another point which seems desirable, if not necessary, is in all those places where the reservoirs are not large enough to contain a two years' supply of water, to have a few wells constructed on the fields below. These should not be made, however, without taking into consideration the soil and subsoil, the cost of other wells in the neighbourhood, and the irrigation carried out by means of them, etc.

It is a known fact—tested and proved often in this State—that the ground below a tank is affected by the tank; and in a dry season, when the reservoir perhaps was empty, the cultivator is able to work his well and save himself and his cattle.

4. *Rainfall.*—A reference to the table of rainfall for the Jaipur State will show how precarious this source of supply is. In 1879 the average for the State was 35·88 inches; in 1877 it was 10·66 and in 1899 was 12·72. One has to be prepared for extremes. It shows how necessary it is to store all the rainfall possible, so that the bounty of good years may help to make good in some measure the deficiency in bad years. It shows also how desirable it is to have *large* reservoirs, which shall be capable of storing sufficient for at least two years. It is in this respect that all small tanks fail; at the very time they are most required, perhaps they are dry. Much depends on the nature of the rainfall; whether an average fall, or whether it is received when the ground is dry and allows it to run off freely, or whether it spreads over a long period and comes in gentle falls, which, though so beneficial to the crops, do not fill the *talaos* or reservoirs. In 1899 in the Western District only 2 tanks filled, 29 partially filled, and 34 remained empty. The rainfall was 12·72 inches average for the State. In 1898, out of 63 tanks in the Western District, only 2 overflowed, 7 filled, 39 partially filled, 17 remained almost empty. The rainfall was 15·32 inches. The heights of water in the tanks as filled during the rainy season of 1900 are shown in the printed annual report. In the present year, 1901, in October, nearly all are dry in the south-western part of the State. The rainfall of the monsoon months, 1st June to 30th September, has been only 10·48 inches. In 1899 the three largest reservoirs in the Western District filled only partially, and irrigated only the areas stated, *viz.*—

				Bighas.
Tori Sagur only filled	15	out of 30	feet, irrigating	11,948
Chaparwara	„ 7	„ 16	„ „	22,227
Kalegh Sagur	„ 20	„ 26	„ „	5,177
			Total	39,352

while in good years the irrigation has been respectively 30,000, 26,000, and 24,000, making a total of 80,000 *bighas*. It will be seen from this how great the loss was in this year, 1899. The water was almost all spent in watering the *kharif* crops, but was the means of saving a large share of them. This year, 1901, Tori Sagur has saved about 10,000 *bighas* of the *kharif* crop.

5. *Irrigation begun.*—Little appears to have been done in the way of irrigation in the Jaipur State previous to A.D. 1868, although the remains of a few small works existed here and there; and in the villages of some of the *jagirdars*, tank irrigation in a small and primitive way was carried on. The success, which attended the efforts of the late Colonel Dixon in the Ajmer and Merwara districts of Rajputana, showed what benefits might be derived from storing water in suitable places.

6. *Progress.*—In 1868 the expenditure was only Rs. 227 on irrigation, but a beginning had been made. The attention of the Durbar having been drawn to irrigation, sanctions were given as new projects were brought forward, and the enlightened and liberal policy begun by the late Maharaja H. H. Sewai Ram Singh has been cordially continued and encouraged by the present Maharaja H. H. Sewai Madhu Singh. The expenditure in 1900, the famine year, was Rs. 5,31,015. This policy was well supported by Rao Bahadur Babu Kantee Chander Mukerji, C.I.E., who died in January 1901, while serving as a member on the Famine Commission, and whose death has been a great loss in many ways to the State. All who see the results cannot fail to approve such a policy. The present Members of Council are alive to these advantages and readily support all irrigation projects. The money laid out is all spent in the State and cannot fail to do good. It is satisfactory to notice, too, the steady way in which the area under irrigation has increased. *(See Appendix I.)*

7. *Number of irrigation works in the Jaipur State.*—The total number of irrigation works in the Jaipur State, under the management of this Department, is—

Completed works	165
Works in progress	29
Total .	194

The total number of irrigation works includes two supply canals—one from the river Mashi at Etagoi, one from the river Bandi at Hingona. These have been described further on. Ninety are old tanks and 104 new works. It should be observed, however, that all the old tanks were of little or no use until properly surveyed and reconstructed on sound principles and irrigation channels aligned and properly graded. All the works noted have been carried out since 1868, since Colonel S. S. Jacob has been here in this State, assisted by the late Mr. T. W. Miles, Executive Engineer, from 1873 to 1878, and Mr. C. E. Stotherd from 1896. The main ducts, which vary in width from 5 feet to 20 feet, comprise a total length of 807 miles with 637 miles of distributaries.

A statement of areas irrigated in acres *annually* is attached. *(See Appendix I.)*

8. *Quantity of water which can be stored.*—The total quantity of water which can be stored by the tanks annually, if they filled, is 15,787 million cubic feet; and allowing 120,000 cubic feet as sufficient for three waterings of one acre, there would be (if they all filled) enough water to irrigate 131,558 acres.

9. *Map.*—The accompanying map shows the position of each work.

10. *Printed statement showing nature of each work, drainage area, etc.*—A printed statement is kept up annually showing the nature of each work, whether new or old, drainage areas, capacity, length of distributaries, areas capable of irrigation, duty of water, expenditure up to 31st December, and returns up to 31st August, the end of the Raj year. A copy of this statement is attached.

11. *Expenditure for 1900, and returns.*—The year A.D. 1900 was a famine year; the total expenditure on irrigation works during this year was Rs. 5,31,015-0-7. The total estimated revenue was Rs. 1,96,415.

12. *Capital outlay.*—The capital outlay, which includes any outlay on repairs during the year up to the end of 1900, is Rs. 57,77,444. This does not include establishment, which is employed on construction and repairs of irrigation works, as well as on roads and buildings. It does not also include the cost of revenue collection, which is done by the ordinary revenue Durbar officials. In some cases it has been found necessary to add masonry corewalls

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* Not printed.

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a few years after the work has been made; also it is considered desirable to show the return upon the *total* cost of the work, otherwise the percentage might appear higher in some years than it really is. For these reasons the cost of anything done to the work each year has been added to the *original* cost. The revenue for the year is believed, therefore, to be the fair return on what has been expended from the beginning on each work.

13. *Works taken over by the Durbar.*—A few works, which were made by this Department, have, for State reasons, been made over to the Durbar, and so have passed from the control of this Department. The revenue from these works is not known, and is therefore not included; but the expenditure on them up to that date is included in the figures quoted above, *viz.*, Rs. 57,77,444.

14. *Total returns.*—The total return on the above capital cost up to 31st August 1900 is approximately Rs. 46,68,555. This being the total of the annual statements supplied by the Raj officials.

15. *Average percentage of returns on outlay.*—The average percentage of return on outlay taken over a period of 11 years is 8.

16. The capital average cost of irrigating an acre is Rs. 49-3-0.

17. In the Annual Report of the Public Works Department printed every year, the details of the revenue, the nature of the crops, the area irrigated by flow and by lift, the shares of *khalsa* and *jagir*, the cost of supervision and guarding, and other details are noted.

18. *Details for the past year, 1900.*—For instance, taking the past year, 1900, the revenue for the year ending 31st August 1900 was Rs. 1,96,415.

	DISTRICT.						Total.		
	East.			West.					
	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.
By water-rate . .	23,527	6	9	20,424	1	9	43,951	8	6
,, share of produce .	89,447	1	6	57,100	8	3	1,16,547	9	9
miscellaneous .	4,512	6	6	1,374	3	0	5,916	9	6
Total .	1,17,516	11	9	78,898	13	0	1,96,415	11	9

The cost of supervision and guarding was—

	Rs.		Rs. A. P.
For the Eastern District,	7,494,	cost per acre irrigated .	0 12 0
For Western do ,	10,712	do. do. .	0 15 0

The areas irrigated were—

	EAST.		WEST.		TOTAL.	
	Bighas.	Biswas.	Bighas.	Biswas	Bighas.	Biswas.
By flow . . .	23,929	6	28,824	12	52,753	18
,, lift . . .	2,858	17	3,125	5	5,984	2
In tank beds . .	3,964	10	2,651	3	6,615	13
,, *khalsa* gardens .	...	.	16	10	16	10
Total .	30,752	13	34,617	10	65,370	3

The areas cultivated were—

	EAST.		WEST.		TOTAL.	
	Bighas	Biswas.	Bighas.	Biswas	Bighas	Biswas.
Single crop . .	20,881	1	31,949	17	52,830	18
Double crop . .	5,907	2	...	...	5,907	2
Total .	26,788	3	31,949	17	58,738	0

The following is the share of *khalsa* and *jagir* :—

	EAST.		WEST.		TOTAL.	
	Bighas.	Biswas.	Bighas.	Biswas.	Bighas.	Biswas.
Khalsa . . .	16,315	13	23,865	12	40,181	5
Jagir . . .	10,472	10	8,084	5	18,556	15
Total .	26,788	3	31,949	17	58,738	0

The description and area of each sort of crop are noted by the zilladar in his annual report (*vide* pages 105—108 of the Public Works Department Annual Report).

19. *Diagram showing the rainfall, expenditure, and revenue.*—The diagram attached shows at a glance the rainfall for the year (blue), the amount spent on irrigation (red), and the returns realised (green) for each year since 1872. It should be observed that this expenditure includes money which has been laid out on surveys of several works which have not been yet taken in hand, and on some other items which cannot be classed as remunerative. In future the areas irrigated will be also shown.

20. *Increase of revenue before and after irrigation.*—The two statements marked A and B show the increase of revenue before and after the introduction of irrigation in nine tahsils of the Western District of the Jaipur State.

The figures are taken from the returns supplied by the Raj officials; the period extends over 16 years in each case, and includes in the latter period three years of famine or scarcity.

The average annual increase of revenue for these nine tahsils is Rs. 1,78,167. (See Statement A.)

21. *Expenditure on Works.*—The total expenditure which has been incurred on irrigation during this period in these nine tahsils is Rs. 25,55,354; the increased revenue for the same period is Rs. 28,50,679. While about 78,487 *bighas* (equivalent to 26,162 acres) previously uncultivated have been brought under cultivation. (Statement B, columns 5, 6, and 10.)

22. *Abpashi establishment described.*—The Abpashi establishment, that is, the establishment concerned with everything connected with irrigation, except the engineering or professional part of the work, consists of—

2	zillahdars,
2	naib-zillahdars or deputies,
4	girdawars or inspectors,
15	mohurirrs or munshis,
2	amins.
203	mahafizan or guards distributed over the works and lands irrigated.

The Jaipur State is divided into two districts, east and west: half the establishment looks after the eastern and half after the western part. Each irrigation work is looked after by one or more mahafiz. These men, who must be natives of Jaipur, have to furnish a security of Rs. 25 each. They are provided with printed books in which the details of the area irrigated daily is approximately entered by the patwari of the village; they have a simple uniform of loose jacket and pagri, coloured green, with leather belt and a hatchet, for clearing away boughs of trees and thorns. The mohurirrs look after the mahafizan of certain areas and check the entries and their work generally. The girdawars go round inspecting larger areas and supervise all under them. The zilladars and naib-zilladars go on tour occasionally, and are responsible for the whole areas and men under them. They keep a journal and show it on return from every tour. At the close of the irrigation season, the irrigated lands are all measured up by the village authorities with a standard chain 120 feet long, and the members of the Abpashi establishment, and the results compared with the daily registers. A printed memo. called "parcha khatoni" is filled in and given to each zamindar, intimating the amount to be recovered from him, and a copy is sent to the tahsil for information. The amount is recovered by the Raj authorities, in the same way as the land-revenue is realized, by the ordinary revenue establishment. This Department has nothing to do with the collection of the revenue.

23. *Abpashi Code.*—With the approval of the Durbar, a book containing simple rules for the guidance of all concerned has been printed and is known as the Abpashi Code.

24. *Water-rates in force.*—The water-rates in force are as follows, and are uniform for all works and independently of the number of waterings given, *viz.*, for ordinary crops, for *khalsa* :—

By lift, 4 annas a *bigha* or 12 annas an acre.
„ flow, 8 „ „ „ Rs. 1-8 „ „

For *jagir* double of the above. A double rate is charged for the following:—Rice, sugarcane, opium, caraway, indigo, lucerne, tobacco. The water is distributed, as far as possible, according to the quantity available, usually two or three waterings. Where crops fail to come to maturity and good reasons exist, the Durbar officials make remissions according to circumstances. The irrigation season for the *kharif* is during September and October, and for the *rabi* during October to February.

*25. *Share of produce how taken.*—Share of produce is taken as follows:—

For the *kharif* crops in cash, *viz.*, cotton, Indian-corn, sugarcane, rice, tobacco, indigo.

For other *kharif* crops, such as til, bajra, juar, moth, etc., in kind.

For the *rabi* crops in cash, for zira, opium, lucerne and vegetables in cash.

For other kinds, *viz.*, barley, wheat, gram, etc., in kind.

The cash value is determined by the tahsildars of each district after consultation with the village authorities, and the share of produce varies according to the caste of the cultivator.

The greatest taken is half from Jat, Gujar, etc., and the lowest one-quarter from Thakurs, Brahmins, etc., and other high castes.

In *jagir* lands the State only gets the water-rate, and for this reason, and because the *jagirdars* do not contribute towards the cost of the works, the charge is double.

The returns shown in Appendix F of the Annual Reports as amount of share of produce are furnished by the tahsildars, who are supposed to deduct the share due to land cultivated, before the tank was made, or that would not have been cultivated but for the tank; and so these returns may, it is believed, be fairly creditable to the works.

26. *Regarding distribution of water.*—It is optional to take water or not. No guarantee is given as to the number of waterings which will be given. Each village is supplied in rotation; and if there is not sufficient to give a full supply, the zilladar of Abpashi intimates the share that may be expected. Whether full or half share or less, according to the amount available.

27. *Kyaries.*—Until lately it was the rule to insist on *kyaries* or beds being made of not less than 40 feet square with the object of economising the water. But there were so often disputes as to whether *kyaries* had been made or not, and it left an opening for so much dishonesty on the part of the mahafizan, as well as of the zamindars, that it has been decided to abolish this rule. *Kyaries* are not now compulsory, but the water-rate has been raised from 8 to 10 annas per *bigha* for *khalsa* (equivalent to J. R. Rs. 1-14-0 per acre) and double this for *jagirdars* and others. The reason for charging them double is because they receive also a share of the produce; none of which goes to the Durbar from their tanks.

28. *Method of dealing with tanks where the water-supply has been intercepted.*—One of the difficulties met with in the construction of supply canals was, where the canal intercepted the surface drainage from reaching existing tanks, situated below the canal. The owners naturally objected to having the supply intercepted. The rule made is, to put a sluice opposite to every *talao*, and when it rains this sluice is allowed to remain open. When the rain ceases it is closed. No water-rate is charged on such tanks. It is possible the tank may receive more water than it otherwise would, but this is a point on the right side. All allow that they have been fairly treated, and so far the system has worked well. Tanks which have been made after the canal, if they receive water from the canal, have to pay water-rate. So also those who take any water from the canal, when it is not raining, are charged water-rate.

29. *Ratio of discharge from drainage areas.*—Arrangements are being made to record and register the contents of the larger irrigation works so as to be able to calculate the ratio of discharge or run off from the drainage areas. There is great difference in this, varying as it does from the configuration of the ground, the nature of the soil, the duration and force of the rain, etc. At Beochara, in 1897, the rainfall was 16·12 inches, which filled the reservoir 60 feet deep, giving a ratio of run-off of nearly 23 per cent. In 1899 the rainfall was only 10·85, but the run-off was 34·3 per cent. (Assistant Engineer's Annual Report for 1899, page 2.) At Ramgarh the run-off was 20·6 per cent; at Sainthal, 21·4 per cent. At the Amani Sha reservoir, which has a drainage area of about 13 square miles, mostly very sandy, the run-off has been as low as $\frac{1}{20}$th. The ratio adopted in the preparation of irrigation projects in the Jaipur State is $\frac{1}{10}$th, which is generally on the safe side.

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30. *Duty of water.*—The duty of water is calculated at 120,000 cubic feet per acre, which is considered sufficient to meet all demands of leakage, evaporation and irrigation, in all ordinary cases. Calculations made from certain tanks prove that this is a fair allowance. It represents a depth of nearly 3 feet over the acre.

31. *Value of irrigation tested.*—In order to test practically the value of irrigation, the following experiment was carried out in 1881. At Mora Sagur 3 *bighas* of land were taken close together; the ground is good stiff soil. One *bigha* was watered three times; the second *bigha* was watered once only, and the third not at all. The results were as follows:—

	Quantity of wheat produced.			Proceeds.		
	Mds	sr.	ch.	Rs.	A.	P.
1. One *bigha* watered three times	5	22	12	16	1	6
2. Do. do. only once	0	7	11	0	9	0
3. Do. do. not watered	0	2	12	0	3	6
		...		16	14	0
Bhusa		...		0	4	0
Total		...		17	2	0

The outlay incurred was—

	Rs.	A.
Ploughing 3 *bighas*	1	6
28 seers of wheat for seed	2	0
Cutting	0	9
Guarding	0	11
Raj land tax	5	12
Watering 2 *bighas*	1	0
Harvesting and winnowing	1	0
Total	12	6

Taking the expenditure and returns on one *bigha* only, which was watered three times, it is as follows:—

Particulars.				Yield.			Outlay.		
	Mds.	sr.	ch.	Rs.	A.	P.	Rs.	A.	P.
Yield wheat	5	22	12	16	1	6	...		
Bhusa	4	30	0	0	4	0	...		
Ploughing		...			...		0	7	4
Nine seers wheat for seed		...			...		0	10	8
Cutting		...			...		0	3	0
Guarding		...			...		0	3	8
Raj land tax		...			...		1	14	8
Watering		...			...		0	8	0
Harvesting and winnowing		...			...		0	5	4
Total		...		16	5	6	4	4	8
Profit		...			...		12	0	10
Total		...		16	5	6	16	5	6

The above facts prove that here good ordinary soil with three waterings will yield a profit of Rs. 12 per *bigha*, or about Rs. 36 per acre. It also proves that the same land, if not watered or watered only once, will not yield a profit. The profit, therefore, about Rs. 12 per *bigha*, is due to the water, for which the Durbar charge now 10 annas. The water-rate, however, is purposely kept very low to induce the people to take advantage of it, as the profit to the Durbar is on the crop, the Raj share of produce being about one-third of the yield

32. *Regarding suitable soil for bunds and construction of tanks in black soil.*—As regards the soil suitable for tanks, black soil or stiff clay or soil mixed with *kunker* is not considered trustworthy, without a reliable core wall of some kind, because such soils contract and crack with the great heat; and these cracks do not readily close up again, so that when water is admitted (especially if it should come suddenly), it finds a ready outlet through these fissures and causes a breach. Sand, on the other hand, does not contract; if an animal bores a hole in the bank, the soil closes up at once. If it is made thick enough, a sand dam may be trusted; the only point to be guarded against is the weeping away of the bank at the toe of the outer slope, which can be prevented and protected by placing gravel and rubble stone at the toe. The sharp *bujri* or gravel should be put next to the sand and the rubble stone outside. The latter, if placed in sufficient quantity, keeps the *bujri* in its place. This arrangement allows water to percolate, but prevents wasting away of the outer slope. The *bund* at Kalegh, Amani Sha, and Ramgarh are examples of sand *bunds*.

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* See also Note attached, page 24.

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Tanks in black soil, especially if near hills, are not to be trusted to hold water. In black soil, water is not required, as a rule, in seasons of good rainfall; but in average years one watering is desirable, and more in years of drought; these conditions naturally affect the irrigated areas and revenue. Notwithstanding this, there is a keen desire generally to have water stored, so as to be available in case of need. Construction of tanks in black soil, as a rule, costs more than in lighter soil (the soil being harder to work and it being advisable to have a core wall of masonry). Still, where water can be stored at a reasonable sum, and there are cultivators to take it and good land to receive it, there is no doubt that tanks in black soil will be remunerative,—and are quite as important as for other classes of soil.

33. *Relief works.*—The works, on which relief labour was mainly employed, were irrigation works and roads, and the earthwork of railways, and are fully described in a printed memorandum issued after the famine in November 1900. Copy attached. Some new irrigation works were begun; some of these have been completed; the remainder are in progress. All the work taken in hand was of permanent utility, and it has not been necessary therefore to stop any work. (See Final Famine Report, 1899-1900. Copy attached.) Sufficient and useful employment can be found for relief labour for all, who are likely to require it; that is, for natives of the State. Programmes of possible irrigation and other relief works are maintained.

The following are examples of some of the works which have been carried out:—

34. *Khir.*—The remains of an old earthen *bund* existed here. The water had forced another passage for itself through the adjacent hills and all flowed to waste, falling into the Bangunga river, a few miles lower down. The project consisted in closing the gap in the rocky hill with a masonry dam 50 feet high and making up the earthen dam to a height of 60 feet with inner slope 3 to 1 and outer slope 2 to 1. It is about 320 feet thick at the base and 10 feet thick at the top. The masonry dam with an extra 50 feet cut out of the rock at one end is intended to afford a waste weir. As a matter of fact, the water has never reached this height. The catchment area is 27 square miles, maximum capacity 479 millions cubic feet, capable, when full, of irrigating 3,994 acres. The length of irrigation channels about 78 miles. The outlet is an ordinary iron sluice with gun-metal edges raised by a vertical rod with screwed head. The total expenditure up to December 1900 on this work is Rs. 1,15,794. The total revenue realised up to August 1900 is Rs. 1,35,598. It was completed in 1877. The average annual revenue realised is Rs. 5,896, giving a percentage of Rs. 5·09 on the total outlay.

35. *Kalegh Sagur*—Is situated about 20 miles northwest of Jaipur, and is formed by a dam across the river Bandi at the rocky spur of Kalegh. The dam is entirely of sand. The greatest depth of water is 30 feet. The reservoir when full covers an area of about 2·4 square miles and contains 578 millions cubic feet, capable of irrigating 28,000 *bighas*. At one end, where the sand dam joins the rocky spur, a masonry core wall has been built to prevent the water creeping along the face of the rock. An escape has been made by cutting a gap out of the rocky spur down to high water level. The sluices have been put in a channel 10 feet wide cut still lower through the rock down to 25 feet below high water level. All the material which came out of the cutting, made for the escape, was used in covering over the inner slope of the sand *bund*, and in protecting the toe at the outer slope from weeping away. The head works are situated about six miles lower down the river, as the land on each side is not suitable for irrigation. At this point a masonry weir, 15 feet high, has been made on a bed of rock and raises the water and diverts it to the canal which passes away on the right bank until it reaches the water-shed of the country beyond. Until it reaches this point, it intercepts all the surface drainage from the ground above it on the right, and instead of all this water being allowed to go to waste as hitherto, it is now conveyed by this canal to fill village tanks beyond. Thus the canal in the rains acts as a feeder or supply to the village tanks, and after the rains, when the sluices of Kalegh Sagur are opened, it leads the water, which has been stored there, to the fields for irrigation, fulfilling a double purpose. The total expenditure up to December 1900 has been Rs. 2,79,448. The amount of revenue realised since its construction up to August 1900 is Rs. 6,06,143. This gives an average annual return of Rs. 24,246 and percentage of Rs. 8·67 on the outlay.

36. *Bund Madho Sagur, Gerowli.*—This work is situated about 50 miles south-east of Jaipur and was begun in 1886. The mean length is 855 feet. The high water level is 30 feet above ground line, 45 feet above nullah bed, with a masonry core wall. It has a drainage area of about 26¼ square miles; the dam has been made purposely larger than is required for this area, in order that the Moroli nullah to the west may be diverted to it some day. The escape is cut out of the rock at the east end 35 feet above the bed of the nullah. The capacity, when full, is 838 million cubic feet. The length of irrigation ducts and distributaries is about 37 miles. The expenditure up to December 1900 is Rs. 1,90,725. Total revenue realised up to August 1900 is Rs. 1,46,062. It was completed in 1887. The average annual revenue is Rs. 11,236, giving a percentage of Rs. 5·89 on the outlay. One object in making this *bund* was to control the floods. The Choi nullah, after passing through the gorge at Gerowli, spreads over the country without any clearly defined channel; it used to deposit silt right and left and do much damage, so much so that petitions were received from 19 villages, praying that some remedy might be adopted. In addition to this, in heavy floods this breached the road to Agra for about one and-a-half miles in length and threatened the large village of Sikrai. Attempts were made to protect Sikrai by throwing out spurs, but experience showed that the only way really to stop the damage was to bund the nullah up entirely at the Gerowli gorge. This has been done; the damage has ceased and the water which formerly did harm is now stored for irrigation, and every drop is used and benefits the villages below.

37. *Tori Sagur*—Is situated about 50 miles south-west of Jaipur. The catchment area is about 320 square miles, all the water from which every year flowed to waste. The *bund* is of earth 6,400 feet long, with a masonry core wall for a portion of its length where there is rock. The area, when full, is nearly 6 square miles. The greatest depth is 40 feet. The contents, when full, 2,057 million cubic feet, capable of irrigating 17,189 acres. The total length of main canals is about 55 miles and of distributaries about 122 miles. The escape is on the rocky ground at the south end 800 feet in length. On the 9th August 1888 there was a heavy fall of rain here, 8·45 inches in nine hours from 5 to 11 P.M. and from 12 to 3 A.M. The waste weir overflowed 2 feet deep and continued running for 29 days. The sluices are all in duplicate of iron with gun-metal faces, with vertical raising rods with screwed heads. One set is always open in case the working set should at any time need repair. A turbine has been fitted on to one of the outlet pipes and the head of water is used to grind corn before it passes on for irrigation. The water now spreads up to the village of Myron; if the high water level can be raised without damage to this village, it could be easily done at a very small cost, and the matter is under consideration. The expenditure up to December 1900 has been Rs. 6,03,269, and the amount of revenue realised since its construction in 1887 has been Rs. 5,76,551, giving an average annual return of Rs. 38,437 and 6·37 percentage on the outlay. This year, 1901, it has saved the *kharif* crops on about 10,000 *bighas*, about 38 new hamlets have been founded below it, on lands which formerly were jungle and waste.

38. *Mora Sagur.*—This work is situated about 50 miles south-east of Jaipur. It is an earthen dam, 3,380 feet long, with a masonry core wall which was put in afterwards. When full it has an area of over two square miles. The catchment is surrounded by hills. The capacity of the reservoir, when full, is 456½ million cubic feet, capable of irrigating 3,471 acres. The length of main and distributaries is 59 miles. The country below depends upon tank irrigation; the soil is very good, so the benefit that this work has done in storing all the water which formerly passed to waste is great. The high water level is being raised now another two feet at the small cost of Rs. 823. This will add about 111 million cubic feet to the contents. The expenditure up to December 1900 is Rs. 1,68,273. The revenue realised up to August 1900 is Rs. 5,19,669, giving an average annual return of Rs. 21,653 and percentage of Rs. 12·86 on the outlay.

39. *Bund Binouri and Supply Cut.*—About 65 miles south-east of Jaipur a small stream, almost perennial, existed at the village of Binouri. Before 1868 the natives after every monsoon used to make a sand dam across the stream to divert the water by a small winding duct to Liwalli. All the flood waters were allowed to go to waste. Every year the *kachcha* bund had to be renewed and often just as it was made, a freshet came down and it was breached. A high earthen *bund* was made across the nullah and a masonry escape on the solid ground on the east bank. A channel 20 feet broad was dug towards Baminawas to convey flood waters to the many large

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tanks near it and the small duct to Liwalli was realigned. By these means a portion of the flood waters are diverted and the water stored for irrigation, and the expense and trouble of making up the earthen *bund* annually is saved. As a good deal of water still passed away over the weir, one of the two nullahs above it was completely closed by an earthen dam 32 feet high, without any core wall, and a few years afterwards, this *bund* was extended southwards to give an extra supply of 39 million cubic feet, by filling a *jhil* into which the water flowed after Binouri Sagur had filled 7 feet. By this means a large quantity of water is stored and can be let out to fill up tanks below or for irrigation as desired:—

	Rs.
The total expenditure up to December 1900 has been .	1,72,060
The revenue realised from 1876 to August 1900 . .	2,39,800

giving an average annual return of Rs. 9,999, equivalent to Rs. 5·81 per cent. on the outlay.

40. *Boochara Reservoir.*—Is situated about 60 miles north of Jaipur. The dam is of solid masonry 75 feet high. The gorge in which it is placed is 130 feet wide at the bottom and 480 feet at the top. The drainage area is about 80 square miles, mostly hill and rocky soil. The area of the reservoir, when full, is about 1·74 square miles, and the contents 1,329 millions cubic feet, capable of irrigating about 11,000 acres or 33,000 *bighas*. It was completed in 1887. That year it filled brimful, and the surplus water passed over the escape 166 feet long, running about 9 inches deep for nearly five days. In 1893, on the 11th July, although only a little rain fell at the site of the dam, there was an unusually heavy fall over the drainage area. The water, which stood 58 feet deep, began to rise rapidly, and in about 8 hours rose to 75 feet and overflowed by the four escapes: total length 814 feet, flowing for some hours from 3½ to 4 feet deep, tearing ravines in the rocks in some places about 100 feet wide and 50 feet deep. No damage, however, occurred to the works. The waste weirs Nos. 2 and 3 have since been raised 5 feet. Owing to the difficulty of getting the water away and the contracted area at the bottom of the reservoir, the outlet sluices, which as usual are in duplicate, were put at a height of 20 feet above the bed, the canal was taken through a saddle back in rock in 20 feet excavation for a short distance, and after that there was no difficulty—

	Rs.
The total expenditure up to December 1900 is . .	3,39,447
The revenue realised up to August 1900 is . . .	2,14,254

giving an annual average return of Rs. 14,284, equivalent to a percentage of Rs. 4·20 on the outlay.

41. *Chaparwara Sagur*—Is situated about 40 miles west of Jaipur. The *bund* is of earth with a masonry core wall 13,200 feet long. Its catchment area is about 230 square miles, the greatest depth of water 17 feet, and contents 1,241 million cubic feet, capable of irrigating 10,340 acres. The area of the reservoir, which is a shallow basin, when full, is about 4·85 square miles—

	Rs.
The total expenditure up to December 1900 is .	5,18,435
And revenue realised up to August 1900 . . .	1,33,884

In 1898, although the rainfall was only 15 32 inches, rain fell heavily on the 19th and 20th July over the catchment of this reservoir. The tank filled in about 24 hours and overflowed for about 15 days. Greatest depth 6 inches; length of weir 145 feet. This year, 1901, although the rainfall from June to October was 6·83 inches, only about 1 foot of water came into the reservoir. A project is being carried out to bring flood water from the river Mashi near Etagoi by a canal 13½ miles long, 30 feet wide, to this reservoir at a cost of Rs. 83,919. Eight miles are done, 4 remain to be done. A masonry weir has been already made across the river Mashi to supply this canal, as well as a similar canal on the right bank, which has been made 23 miles long to supply all the tanks in that direction. Where this canal crosses any nullahs or drainage lines, these have been, or will be, all bunded up, and every drop of water will be secured.

42. *The Ramgarh Dam* (*Crosthwaite Sagur*).—The project consists in bunding up the river Bangunga near the village of Gopalgarh about 3 miles east of Ramgarh and 20 miles north-east of Jaipur. The drainage area above the proposed site is about 297 square miles. The original idea was to make a masonry dam at the narrowest place of the gorge in the hills through which the river has apparently forced its way, but the difficulty in finding rock at a reasonable depth caused this site to be abandoned in favour of one a few hundred feet higher up, where it was possible to make a large sand dam, with rock at the south end for the escape. The foundation stone was laid by Sir R. Crosthwaite, Agent to the Governor-General for Rajputana, on the 30th December 1897, at the request of H. H. Maharaja Sewai Madhu Singh.

The first year an outlet channel 800 feet long was excavated along the toe of the rocky hill at the south end of the *bund*. A masonry retaining wall was begun along one side of this channel with 3 cross walls from it, all founded on rock, running into the sand dam to prevent any percolation along the wall, and a certain amount of the sand dam was made; the water in flood going for the last time as usual down the old course. After the rains the river was closed with the sand *bund* and carried up to a height of 60 feet; the masonry wing wall and cross walls being also built up. A core wall of "*morinda*" (sand and clay mixed) was made in the centre of the *bund* 20 feet thick. The foundation for this was taken as deep as could be managed, about 6 feet only, and it was built up with a batter of 1 inch to the foot on both sides. It is not supposed that this core wall will stop leakage, but it will prevent percolation through the body of the *bund*; any percolation from below being allowed to escape freely by the broken stone placed at the toe of the outer slope. The second year was a critical time. The old course of the river having been bunded up, all the flood was allowed to escape by the channel through the rock at the south end. Three floods occurred; the second on 26th to 29th June was the heaviest. It scoured a deep hole at the end of the channel, but was prevented from cutting back by the rocky bed at this point. After the floods of the second year were over, the rocky channel and the gap between the sand dam and the hill at the south end was closed by a masonry dam, in which the sluices for irrigation have been constructed. These consist of 6 openings, each of 2 feet diameter, 2 of them at 20 feet, 2 at 40 feet, and 2 at 60 feet from the top. There are similar sluices in a well in front of the former which can be used in case of need to shut off or admit water should anything occur to make it necessary. The work has been done mostly by portable tramway, 16 inches gauge, with side tipping wagons; but men and bullocks have also been employed. The material for the *bund* has chiefly been brought from the sand hills to the north, the average lead being about 1·500 feet.

The details of the work are—

	Feet.
Height of dam	90
" to H. W. L.	70
Length at top	1,080
Thickness at the base	670
" " " top	30

Allowing 22 inches as the average rainfall and $\frac{1}{10}$ as the run-off, there will be impounded about 1,518 million cubic feet of water. The H. W. L. at 70 feet will correspond to 2,689 million cubic feet. It will probably not fill up to this level, but at this height an escape is more easily provided, and it is well to be prepared for heavy floods and to be able to store all the water of good years. All the water which came down the river in 1901 has been impounded, and is now being used for irrigation, and in a few months it is hoped the *bund* will be finished. The head-works of the irrigation canal are situated about a mile lower down the river, where it is possible to take a canal away clear of the hills. It has been taken below the well lands of the village of Khoa at the request of the villagers, and after crossing two small nullahs by masonry aqueducts, it follows the water-shed to Dosa and tails into the Gai Talao, a large tank near Dosa. The main canal is 20 feet wide, 23 miles long. The total fall is about 105·17. This has been broken up into small falls of 2 feet or so at every convenient place, and ducts for irrigation are taken off above every fall. The total expenditure up to December 1900 is Rs. 3,47,515. The work is not quite completed yet, so it is too soon to speak of the returns; but to be able to retain and use all the water of this large river is a great thing, and there is every hope of it proving a useful and remunerative work.

43. *Weir on the river Mashi.*—The river Mashi is one of the largest rivers in the Jaipur State; it rises in the Kishengarh State on the west, enters the Jaipur State near Etagoi, and joins the river Banas nearly opposite to Tonk. For some weeks the water used to be flowing here, but of late years the bed has been dry. In 1884 it was proposed to put a small *bund* here and take a supply cut to Gunwar. Rs. 69,952 were sanctioned; Rs. 26,083 for the weir and Rs. 43,869 for the supply canal. The supply canal to the Gunwar Tank was made 20 miles long, 15 feet wide,

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average depth 3 feet, starting at a level of 4 feet above the bed of the river Mashi. The construction of the weir was postponed chiefly because the Gunwar Bund had been twice breached, and it was considered better to put a masonry core wall here and make this reservoir secure before anything else. The saving thus effected was utilised in making masonry core walls to Ram Sagur and Pambolao, both at Gunwar. After this the question of making a *bund* at Etagoi was considered, and three alternative projects were brought forward with depths of 12 feet, 22 feet, and 17 feet of water. The first was rejected as not retaining enough water to be of any real good; the second, to retain 22 feet of water, was also rejected, as it would submerge land of Etagoi and some in the Kishengarh State which might cause difficulties. The last 17 feet depth of water has been postponed for the present; for, although it would submerge only a small portion of Kishengarh land and would probably be rather beneficial than injurious, yet there is some uncertainty as to the amount of water available, as there are several *bunds* in the Kishengarh State which cut off some of the drainage. So it is considered better for the present merely to make a masonry weir across the river, which will divert the flood waters down the canals and enable the floods to be gauged. At the site, where the weir has been made, the drainage area is about 216 square miles, and the river has a fall of 6·25 feet per mile. The weir consists of a masonry wall 479 feet long, 8½ feet thick; the top is 4 feet above the canal bed, with a batter on the outer side of 3 inches to the foot. Both sides have been continued by earthen *bunds* 700 feet long on the south side and 300 feet long to the north, with top widths 10 feet, inner slopes 4 to 1, outer slopes 2 to 1. The top of the *bunds* are 11 feet above the top of the weir. Masonry core walls have been put 50 feet long on the north side and 61 feet long on the south to connect with the weir, the ends being protected with rubble pitching. A scouring sluice has been left 10 feet wide in the weir, which is temporarily closed with masonry. On the downstream side a good part of the apron is on rock, and where there is no rock a rubble stone apron has been provided, slopping 1 in 20, the toe of which is formed of massive concrete blocks about 10'×5'×4' built 2 feet into the bed of the river. The canal, which takes off on the right bank, has been widened from 15 to 30 feet as a useful relief work during the late famine. The head-works are provided with seven openings, each 4 feet wide, which can be regulated by wooden shutters worked by a chain with counterpoise over an overhead wheel, supported on a horizontal framing of old rails. A canal 12 miles long from this weir is being now made on the north or left bank, 30 feet wide, to increase the supply to Chaparwara Sagur, the waters of 2 nullahs which are crossed *en route* being also diverted by masonry bunds across them and made to join the canal. Wherever tanks are situated below the canal, sluices are provided so as to enable them to be supplied in the rains and remove any complaints that might be made on this score. These sluices are kept closed except when it actually rains. Water taken at other times renders those who take it liable to pay water-rate.

44. *Hingona weir on the river Bandi.*—A masonry weir has been built across the river Bandi, 5 feet high, at a place where a ledge of natural rock crops out across the river-bed near the hamlet of Hingona. On each side *bunds* of sand have been made, the ends of which are protected by masonry and rubble pitching. A canal has been taken from this weir to the village of Sahadra about 2 miles distant, where an earthen *bund* has been lately made. All the water which cannot pass down the canal is allowed at present to escape over the weir. A project is being prepared for raising the weir 8 or 10 feet and forming a storage reservoir to retain the water for a time. There is a magnificent storage basin, and the Thakur of Mahal, who originally objected to this being flooded, now wishes it done. A canal will then be taken from this reservoir, by which water can be conveyed to fill tanks in the rains or for irrigation afterwards as may be desired.

There are many other interesting works, but probably the above are sufficient to illustrate the attempts which have been made to store and utilise water for irrigation.

45. *Silt.*—As most of the irrigation works have been carried out, where the soil is good and stiff, no difficulties have been experienced as yet on this score, excepting at the Amani Sha, the reservoir where water is stored for the supply of the city of Jaipur. The slope of the bed of the nullah is about 16 feet in a mile. The banks here are 61 feet high, the soil is loose sand, consequently whenever there is a heavy fall of rain a great deal of silt is brought into the reservoir, so much so that the pipes by which the water is drawn up, and which originally were placed 5 feet above the bed of the nullah, are now 12 feet below it, and great difficulty is experienced in keeping the mouths of the pipes clear of silt. It was not an easy problem how to keep out the silt and yet to admit the water without losing the head of water. At first it was proposed to run a masonry gallery for some distance up the river bed in front of the pipes, with numerous openings at each side filled with sharp sand to admit the water by filtration, but the experience derived from a large well, which was so constructed and sunk in the bed of the stream some years ago, proved that such openings get clogged with the clay soil around and fail to admit the water properly. A series of large wells was also thought of, to be constructed at intervals up the bed of the stream, and all connected, so that the water might be pumped from the lowest well as a sump. The objections to this were that the head of water would be lost; the cost of raising water from the greater depth would add greatly to the cost of pumping, and the initial cost would be great. The method adopted is to make a *bund* in front of the outlet well of small rubble stones from 2 inches to 6 inches in size, so as to enclose an area of about 300'× 50'. This *bund* will be carried up above high water level; in the present case about 35 feet high. The side slopes to be 1 in 1. On the outer side small stone broken to 1 inch cubes will be placed 1 foot thick all over the outer slope, and outside this a layer of small clean *kunker* gravel, with a layer of broken stone outside this to prevent it from being disturbed. It is hoped that this will act as a filter or strainer, only allowing the water to percolate freely from the nullah to the river enclosure, which can be dredged to any depth and kept free from silt; at the same time it will not matter how much silt comes into the nullah. The water inside the strainer *bund* will always remain the same height as the water outside, and the head of water will not be lost. The work is simple and costs little. It is now in progress.

NEW PROJECTS.

The following have been prepared and the reports regarding them have been printed. They may be briefly described as follows:—

46. *Aloda Irrigation Project.*—Aloda is a *jagir* village about 50 miles north-west of Jaipur and 20 miles west of Sikar. On the west of the village there is a natural *jhil* comprising an area of about 400 acres of shallow water, except in years of scanty rainfall, when it is quite dry. The bed is sandy and charged with *reh*. It is enclosed by high ground to the east, west, and north, and by natural sandhills on the south; there is only one gap to the south through which the surplus water passes off into a nullah. The drainage of about 108 square miles comes into this *jhil*, of which the greater part passes out into the Bai nullah and goes to waste. The slope of the bed is 8 feet to the mile. The *bund* would be 25 feet high, greatest depth of water 15 feet, length at top 5,500 feet, inner slope 6 to 1; as the soil is loose sand, outer slope 2 to 1. The contents at 15 feet contour, 700½ million cubic feet; though it is not expected more than 602 million cubic feet will probably be received, allowance has been made for exceptional years. An escape has been left 100 feet wide at the toe of the Samer Hill; this can be increased in length if necessary, but probably the water will seldom reach the level. The area commanded is about 7 square miles of *khalsa* and 14 square miles of *jagir* land. The estimated cost is Rs. 68,000. The cost of storing the water is about 8,000 cubic feet for one rupee, which is exceptionally low owing to the favourable nature of the site. In the Jaipur State 3,000 cubic feet stored for one rupee is considered very good. Allowing Rs. 2 per acre as water-rate on the *khalsa* and Rs. 3 on the *jagir* land, and deducting 8 annas an acre for maintenance to be on the safe side, the anticipated returns would be about Rs. 5,800, which would give a percentage of about 8·5 on the outlay. If the reservoir filled at 15 feet contour, the area would be 3½ square miles, about 2,184 acres of land would be submerged, of which 780 are good cultivated land and 1,020 waste, as well as 18 wells. Rs. 3,000 have been included in the estimate as compensation for the wells. As regards the submerged land, it is hoped that the benefit derived by deposit of silt coming down in floods would improve the present waste *reh*-covered land and partly, if not altogether, compensate for the good land submerged,

and there would also be cultivation in the margin and bed of the reservoir as the water recedes. Experience alone would prove what the actual loss or benefit would be. As the site is in the lands of a *jagir* the project has not yet been taken up.

47. *Banas Irrigation Project.*—The proposal was to put a masonry weir across the river Banas where it enters the Jaipur State; by which the water, which flows for some months after the floods, would be diverted to a canal, which would be taken off on the right or south bank for irrigation; and also by means of this canal, in years of scanty rainfall, to ensure all the village tanks within its influence being filled, ensuring the district from a water famine. There is no suitable place in the Jaipur State where a storage reservoir on this large river can be made, nor is it possible to take a canal off from this weir on the left bank, owing to the Toda range of hills (at the north end of which is situated the village of Toda Rai Singh), the ground there being about 75 feet above the level of the weir. The width of the bed at the proposed site of the weir is 1,830 feet. The banks are well defined, about 33 feet high. Rock is visible for about 1,100 feet across the bed. This site is situated just within British territory. The drainage area above this point is about 8,190 square miles; the slope of the bed is 1·75 feet per mile. The weir proposed would be masonry, 2,000 feet long, 15 feet high. To prevent the river in flood from spreading or outflanking the weir, it would be necessary to make earthen *bunds* on the south side, 5,500 feet long, and on the north side 15,500 feet long, each 20 feet high at the deepest places. The estimated cost would be about 10 lakhs of rupees. The objections to the project are that little or no water would be stored; no water would be available for irrigation until mile 13, and at mile 20½ the canal would enter the Bondi State. In the first 5 miles the greatest depth of cutting would be 55 feet, and it is impossible to avoid this; and although, if the work was successfully carried out, the States of Bondi and Tonk would no doubt be greatly benefited, yet the heaviest expense would be incurred by the Jaipur State, which could only make use of the water for a very small area. It is possible some arrangement might be made by which all the States that benefited would contribute each a share of the cost, and returns might be adjusted *pro rata* according to the share each contributed. But there are political difficulties which would have to be carefully arranged before this could be done, and control would have to be maintained afterwards. In the meantime it should be noted that this project has been taken up only from a Jaipur State point of view. It is quite possible that there may be some sites on the river Banas higher up, where water could be stored or led off to some large storage basins, which would be far better projects to take up. It seems sad to think that such volumes of water as this large river brings down in flood should annually all go to waste. A printed copy of the report on this project is in the office of the Public Works Department, Jaipur State.

48. *Jai Samand.*—Another project which has been surveyed and estimated is for bunding up the river Kautli where it issues through the gorge in the hills at Jodhpur Sonari, about 60 miles north of Jaipur. The dam to be of earth with a masonry core wall, length at the top 1,017 feet, greatest height 80 feet, inner slope 5 to 1, outer slope 2 to 1. Height above high water level 15 feet, greatest depth of water 65 feet. The contents at this level would be 8,040 million cubic feet. It is not probable so much water will be received, as the catchment, which is about 400 square miles, is sandy, still it is well to be prepared for exceptional years, and for silting up of the bed in the course of time. The area at this level would be about 15 square miles. The estimated cost, if made as above, is Rs. 8,65,816. The probable returns, after deducting for loss and evaporation and maintenance, are estimated at about Rs. 48,000, which would give a percentage of 5·6 on the outlay. In the area which would be submerged are situated the lands of some Bhoomias, who showed such opposition and unwillingness to the project that it was impossible to make detailed surveys to estimate the probable amount of compensation which would be due to them. Rupees 50,000 have been included in the estimate, however, as approximate. No account has been taken of the return which may be realised from cultivation of the bed or margin of the reservoir as the water recedes. The river Kautli is stated originally to have expended itself in the sandy tracts of the Jaipur State in a north-western direction until an unusually heavy flood, some years ago, caused it to alter its direction to the north, and now it enters the Bikaner State, and soon disappears in the heavy sand there. Owing to this fact and to the opposition of the Bhoomias alluded to above, and also to the fact that nearly all the land which would be irrigated is held by *jagirdars*, no action has been taken beyond printing a report on the project, which is on record in the office of the Public Works Department of the Jaipur State. A diversion cut was made from this river near Bagar Salampur in 1900 as a famine relief work and afforded relief to many. There has not been sufficient rain to test the results; but if water can be diverted, as proposed, it will greatly benefit the country adjacent.

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49. *Other works.*—There are other works which can be taken in hand as soon as circumstances permit. The works which have been already done, and the other projects to which allusion has been made, are sufficient to show what has been attempted, and the constant efforts which have been made during the past 34 years to store water and provide for irrigation in the Jaipur State.

APPENDIX I.

Statement showing areas irrigated in acres each year since 1875 to 1900.

Year.	Areas irrigated in acres.	Year.	Areas irrigated in acres.	Year.	Areas irrigated in acres.
1875-76	1,797	1883 9 months	22,872	1892	24,805
1876-77	3,278	1884	16,796	1893	35,119
1877-78	5,966	1885	21,036	1894	34,500
1878-79	4,706	1886	28,429	1895	34,759
1879-80	12,015	1887	22,973	1896	41,334
1880-81	16 395	1888	40,179	1897	27,962
1881-82	14,632	1889	37,239	1898	40 784
1882-83	23,115	1890	42,334	1899	33,258
		1891	32,438	1900	21,790

Under the "*Chakbandi*" system the average of the past five years' actual revenue derived from each village is taken and is let out for fifteen years, each village to the occupants, jointly or separately as they prefer, on an annual rental based on the average. If the cultivators decline to take upon themselves the responsibility, the village is sometimes let out to a third person. Under this system cash rents are taken on the measured *pattis* or holdings irrespective of the crops sown.

Two different methods of assessment prevail in villages which have not been brought under the "*Chakbandi*" system—

1st, *Batai* or division of the produce;

2nd, *Bhej* or money rates per *bigha*.

1. The *Batai* method of assessment is almost always adopted in regard to food-grains (*rabi* and *kharif*), such as wheat, barley, gram, bajra, jowar, til, moong, urd, chola, mote, etc.

2. *Bhej* or cash rents on measured land.

These rates are generally applied to valuable crops other than food-grains, and vary with the kind of crop sown, the caste and occupation of the cultivator, as well as with the nature of the soil.

Cotton, sugarcane, and mukka are the chief *kharif*, and opium, tobacco and jeera, the chief *rabi* crops for which *Bhej* or money rates are taken. The rates vary from Rs. 7 to 1 rupee per *bigha*.

The cultivator is sometimes allowed to retain the State share by paying the money value at the market rate. In case the market rate is not favourable, the Raj share of the produce is taken to and deposited in the State granaries.

The share of the produce taken by the State varies everywhere in accordance with the caste, and sometimes with the occupation of the cultivator.

The agriculturist by caste and profession has to give the State one-half the produce of his fields. This is the *maximum* rate.

Brahmins, Rajputs, Jats, Gujars, and Malis have to pay less.

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The village patel, patwari, chaudhri, and kanungo though they may be agriculturists by caste, have to pay smaller shares. The remission in their case is simply owing to the assistance they always give to the tahsil officers in their work.

The Brahmin and the Rajput are allowed to cultivate land on the most favourable terms. They pay only the *one-fifth* share of the produce, and this is the *minimum* rate.

With regard to the Jat, Gujar, or Mali cultivator, the conditions are not so favourable as that of the Brahmins and the Rajputs. There is, however, a wise restriction in regard to the "favoured castes" as they are called. They are required to cultivate land either themselves or by employing paid servants. They have also to bring their own ploughs and bullocks to the field. In case they let out their holdings to the ordinary agriculturist the maximum share is demanded and taken from them.

In reply to the *President*, the witness said—

1. The work of construction on the irrigation tanks in the Jaipur State is done at the rates ordinarily current in the State. There is no forced labour or pressure of any kind; work is done generally through work agents, who are supplied with all tools except perishable articles, such as baskets, string, etc., and are paid a commission or percentage on the work done, the rates payable to labourers in every case being fixed by the engineers, according to the nature of the soil and local circumstances. In some places work has to be done by daily labour.

2. Small tanks are of no use as a protection against famine. They give employment and store a little water in ordinary years and may assist wells in dry years. There is, however, no minimum as to the size of the tank which it is worth the State's while to consider. It is advisable to stop every drop of water, where it is possible to do so, and it can be done at a reasonable cost.

3. It may be possible to store water in many places along the line of a river or a canal, by making cuts to natural depressions or to village tanks and so ensure a supply of water every year.

4. The canals from the Kalegh Sagur and from the Chaparwara Sagur are instances which show how the irrigation canals may be sometimes useful as the means of conveying surface drainage in the rains to village tanks beyond. The Kalegh Sagur Canal is taken off the right bank of the river Bandee, where a masonry weir 15 feet high has been built to raise the water to the canal. The reservoir (Kalegh Sagur) is 7 miles higher up the river. Until the canal reaches the watershed, it has higher ground on its right and it crosses several small nullahs. Every one of these has been bunded up by the canal crossing it. The canal has a bank on the left side only; the right side is left open, so that all surface water from the higher ground in the rains, after filling up the nullahs to the level of the canal bed, passes off by the canal to fill village tanks, instead of going to waste as it did formerly. Another advantage is that in process of time, these nullahs silt up and the ground can then be cultivated. Bunding up these nullahs causes percolation into the surrounding soil and so benefits any wells near. Previously these wells would perhaps have been drained by these nullahs in the course of time. Similarly, with the Chaparwara Sagur Canal, it follows the general contour of the ground and has a large area, several square miles of country, above it, the surface drainage of which mostly passed off formerly to waste. The irrigation canal intercepts all this and leads it to village tanks, sluices being placed at intervals to allow it to pass off where required to tanks. After the rains both canals are used for irrigation to lead the water from the storage reservoirs to which they belong to the fields, so that they perform a double purpose.

5. As regards silt, it is advisable to make the tanks so high, if it can be done at a reasonable cost, that one can afford to ignore the existence of silt. Eventually a flat alluvial plain might be formed which would be profitable to cultivate. Silt may be diminished by checking the velocity up above by constructing dams to control the water and letting it out gradually as required. The *bund* constructed at Gerowh called "Madho Sagur" (described in paragraph 36, page 10 of my printed memorandum) is an instance.

6. The Banas project (printed memorandum on this shown and submitted to the President) would not pay as regards Jaipur alone. It would chiefly benefit the Tonk State. The discharge of the Banas in flood is about 700,000 cubic feet a second. In November 1883 only 149 cusecs at the site of proposed weir.

December 1883 .	. 103
January 1884 .	. 74
February „ .	. 38
March „ .	. 9
April „ .	. Dry.

A storage reservoir would be necessary to make the project complete. (See paragraph 47, page 16 of my printed memorandum). No use is now made of the Banas river for irrigation purposes, and it is not known as yet whether it is possible. I have had nothing to do with the river Chambal.

7. As an instance of tapping a river weir has been made on the river Mashi, which rises in the Kishengarh State, at a place near Etagoi where the river enters the Jaipur State. (See paragraph 43, page 13 of my printed memorandum.) A canal 30 feet wide has been made on both banks to lead the flood waters to storage reservoirs: one 23 miles, the other 12 miles in length; the latter is not quite finished. Has known of no works made by the co-operation of Native States.

8. The value of water is shown by the readiness of one State to complain of another, interfering in any way with its water.

9. The prevailing depth of wells is 25 to 40 feet generally in the Jaipur State; towards the Bickaneer border the spring level is down to 200 feet or more. Owing to the scarcity of rain of late years the level of the water in the wells in the town of Jaipur has fallen about 12 feet below what it was formerly. The recent famine has given a stimulus to wells.

10. The State make advances and some wells have been recently made; in some cases by the Public Works Department. Rs. 2,90,976 were advanced by the Durbar during the past year as *takavi*, free of interest.

11. Would make dams as high as circumstances permit; often it is better to do this than to spend money in cutting down rock to form an escape; so as to impound all the water it is possible to secure in a year of heavy rainfall, if it could be done at a reasonable cost. I would not try to retain water for two years, as so much is lost by leakage and evaporation; and then if a year of good rainfall occurs the second year, water might escape which would otherwise have been impounded. We should lose this, as well as the benefit which would have been gained by using the water which had been left in the reservoir.

12. *To Mr. Higham.*—Speaking from memory, the effect of tanks on wells extends from ½ to 1 mile or more; the water in a canal also affected wells 500 yards distant on either side, but this depends much on the nature of the subsoil.

13. When a tank is made by putting a *bund* across a nullah, there is sometimes a good deal of leakage down the bed of the nullah; this may often be utilised below by lift, or a small subsidiary weir may be made below which would catch all leakage and enable it to be used by flow or lift.

14. The average total area which has hitherto been irrigated by tanks is between 30 to 40 thousand acres. As, however, we have lately had years of scanty rainfall and some of the large works which have recently been made have not yet had a fair chance, it is hoped this area will be much increased. The Ramgarh reservoir alone should add 10,000 acres.

15. *Q.* In paragraph 8 you say if all the tanks filled they should do 132,000 acres. Do you want a storage capacity of 4 or 5 times 120,000 cubic feet to irrigate an acre?—Yes; if you are depending on surface rainfall alone—by this I mean that, owing to the precarious nature of the rainfall, one's expectations are often not realized. It is very necessary to supplement the supply by tapping nullahs or rivers or by extensive cuts to increase drainage area wherever possible.

16. The duty must be calculated on the actual storage, not on the storage capacity.

17. *Q.* Sometimes a tank fills more than once or overflows? When a tank does fill do you get one acre for 120,000 cubic feet?—We ought to do so. I have not been able to check this sufficiently yet, but it is a very important point and one to which attention is directed. Every large tank is being contoured and the capacity at every foot in height is being registered, so that every year we shall be able to tell the area which ought to be irrigated and so check

waste of water which is often great or find out the cause, as 120,000 cubic feet ought to be ample for an acre including losses by evaporation and leakage. (See last but one page of general statement of Irrigation Works submitted).

18. The Chaparwara reservoir in a year when the tank filled irrigated about $\frac{7}{10}$ (seven-tenths) of the estimated quantity.

19. The height of the *bund* depends on the comparative cost of raising the *bund* and of making an escape. The delay of 25 years in construction of the Ramgarh Bund was chiefly due to a misconception on the part of the Bhartpur State—the next State lower down. There had always been some tension between the two States. The matter was subsequently settled by the Residents and Engineers in a friendly way chiefly by the influence and interest shown in the matter by the Agent to the Governor-General for Rajputana at the time (Sir R. Crosthwaite).

20. *Q.* Have any tanks water left in them at the end of the irrigating season?—Very seldom; tanks generally run dry; large ones in April and small ones after the first sowings; the margin and beds are then cultivated.

21. Whether water should be run off or kept till next year depends a good deal on the shape of the bed and the nature of the soil.

22. Water is only given when asked for and water-rate taken, on the understanding that cultivators may possibly get only one watering. Each village gets its watering in rotation. Every one is free to take water or refuse it. Application is made for water; there is no compulsion, often without specifying area. The zilladar of Abpashi (see paragraph 25, page 5 of printed memorandum for duties of the Abpashi establishment) controls the distribution and decides in what shares it should be given, judging from the amount of water available and previous experience. This and the measurement afterwards of the land irrigated, and general supervision of all irrigation matters with the villages are his duties.

23. The pay of the zilladar and his establishment is included in the total expenditure on irrigation (57 lakhs). This also includes the cost of all surveys—repairs to all tanks; also the cost of the works handed over to the Durbar (see paragraph 13, page 3 of printed memorandum); also a few works which are made more as public improvements than for irrigation. The account is an expenditure and revenue account. The Engineers' pay is not charged against the works, as they are employed on roads and buildings and other works also.

24. As regards figures of areas, revenue, etc., we have to depend on the return submitted by the Tahsildar or Raj officials.

25. The enforcement of "kyaries" has lately been abandoned (paragraph 27, page 6 of printed memorandum), as it led to much dispute and dissatisfaction and gave opportunity for dishonesty.

26. The black cotton soil of Jaipur is much lighter than the black soil of Central India. I have had no experience of land in which water is not taken. I have heard that in the Kotah State water is not so eagerly sought after as not being so necessary in ordinary years, but I am unable to speak from personal experience if it is really so.

27. *To Mr. Ibbetson.*—I am unable to state the proportion of cultivated lands in the State to total area; but both *kharif* and *rabi* are considerable.

28. *To Mr. Higham.*—As a rule, water from tanks is only given to *rabi*, unless it is expected that there will be water to spare. When rain holds off water is given for first sowings of *rabi*, and as many more waterings as possible; but sometimes there is not enough water for this even.

29. There is no doubt that tanks assist wells.

30. *To Mr. Ibbetson.*—I strongly advocate constructing tanks to hold all the water which it is possible to store, even up to two years' supply, if it can be done at a reasonable cost. I would, however, utilize all the water during the first year if there was the demand. To make a tank really protective, it should be large enough to irrigate all the cultivable area within reach twice over and leave a margin.

31. Most of the work of constructing tanks, as regards the earthwork at least, is suitable for famine labour.

32. *To Mr. Higham.*—In the Ramgarh dam the core wall consists of clay and sand mixed; its object is to prevent the body of the *bund* behind the core wall from being saturated with water; it will not stop all leakage, as it was not possible to take it down to an impermeable strata, and no doubt water will leak through from below; but this will drain off at the ground level.

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33. The head-works of the canal for irrigation are situated on the river about a mile lower down and will catch all leakage.

34. The greatest depth impounded at present has been 47 feet; there was more leakage through the sand hills to the north of the *bund* than through the *bund* itself.

35. The toe of the outer slope is made of bajri, then small broken stone; and outside of all, large rubble stones; this allows any leakage to pass away without injury.

36. *Q. By Mr. Ibbetson.*—Is it safe to do this work of making *bunds* with the amount of supervision possible in carrying out famine works?—I have found no difficulty where the soil is sand; and there are no clods; in such cases (of hard soil) there would be a danger of the earth not being properly consolidated unless very carefully supervised. Famine labour in such cases had better be confined to very small works, such as terracing fields or where a breach would not be of much consequence.

37. The water-rates are entirely apart from the land assessment. A man pays his water-rate and share of his produce (generally about one-third) and this goes to the credit of the tank; after deducting old cultivation no addition is made for increased outturn on old cultivation without the aid of the tank as far as I know. The figures quoted are those sent to us by the Durbar officials.

38. I am unable to state extent of area of old cultivation irrigated from tanks; the new is, I believe, much larger than the old.

39. Revenue is also paid on cultivation in tank beds; none from raising of the spring level in wells. No credit is given in the case of the 19 villages near Shigrai which have been protected from silt by the *bund* Madho Sagur at Gerowli (page 10, paragraph 36 of printed memorandum).

40. In one case, Tori Sagur, a small village was submerged by the construction of the reservoir. The Thakur's house and fort and fields, the whole village in fact, was submerged. The Durbar treated them very liberally; full compensation was paid to the Thakur and others; fresh land was allotted above high water level and a large new well made and a new village formed and additional land given below the reservoir. This liberal treatment has had an excellent effect in diminishing opposition to tank projects.

41. A large number of small private *bunds* have been made by Thakurs. The smaller cultivators sometimes terrace their fields, making small earthern banks round the lower end, called in these parts "Nadas." It would be a good thing to help them in this work. The Durbar does always help them whenever the matter is represented. Whenever requests of this kind are made to us, they are sent up to the local authorities and a surveyor or any other help is gladly given. There is great difficulty in getting the smaller men to co-operate for their joint interest; nothing, in fact, would be done at all in *khalsa* lands without State control. I do not think it would be fair to stop work which was first in the field, even though it was likely to interfere with contemplated State work, unless it was a large work calculated to cut off more than the share of the water to which the individual, by position on the drainage area, was fairly entitled to take.

42. Expert assistance is necessary to assist villagers in making small works and whenever it is asked for it is freely given.

43. There is no very large scope in the Jaipur State for making small *bunds* along nullahs; the country is not flat enough generally to admit of long *bunds* and inundation cuts as in the Bhartpur State.

44. *Q.* What works do you recommend for famine relief?—Chiefly earthwork of tanks, canal banks or roads, collection of *kanker*, if the sites are conveniently near; and in some cases breaking of ballast.

45. I should like to make a few remarks as to Rajputana generally—

(1) The facts which strike one are—

(*a*) The great need of water.

(*b*) The necessity there is for storage reservoirs of some kind, owing to the precarious rainfall and the absence of large perennial rivers.

(*c*) That where water has been stored judiciously and economically it has always proved of great benefit and is appreciated by the people.

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(*d*) That no attempt has been made as yet to make use of some of the largest rivers in Rajputana. Every year these carry away an immense quantity of water, which is an *annual* loss to the country.

(*e*) The absence of all data as to whether it is possible to make use of the water.

(2) Hitherto all the efforts in the way of irrigation in Rajputana have been confined to individual States, and have often been taken up or carried out only because of the personal interest taken in the subject by the Engineer officer of the State.

(3) No attempt has been made to look at Rajputana as a whole from an *Imperial* standpoint and all the States of Rajputana as members of one large family, whose interests might be combined.

(4) What has probably hindered any consideration of this sort is perhaps—

(*a*) The difficulties which bristle round any question in which two or more States would be concerned.

(*b*) The want of funds, as most of the States have no money to spare.

(*c*) The absence of data which would enable any project to be brought forward.

(5) The paramount power by its advice or influence can alone remove the difficulties and perhaps provide some means to carry out a large work if it is found possible to bring forward any project.

(6) It may not be possible, after all, to find any suitable project; but until the country is properly investigated, it is not possible to tell.

If it is found to be impossible from an engineering point of view, it is of no use to take any further action.

(7) If, on the other hand, some good projects are found practicable, it will then be time enough to tackle the difficulties which may surround it from a political or financial point of view.

(8) The first step is to get all the information possible, and I do not think any other considerations should prevent this being obtained and obtained without delay, so as to stop, if possible, this *annual* loss of water.

(9) It need not commit any State to any scheme or expenditure. It might be explained to all that the only object in view is their own welfare, the benefit to the States themselves. There ought, then, to be no difficulty in securing their co-operation in this preliminary step at all events.

(10) If this suggestion meets approval, the next question is how it is to be carried out? It is not advisable to put an Engineer officer on high pay to take up each river or separate scheme, regardless of the heavy item of establishment charges.

A man should be appointed whose heart is in the work; a good European officer with perhaps one or two native assistants. He ought to be able then to supervise the work of a dozen native surveyors.

He should make a personal reconnaissance of every large river, taking one or more surveyors with him, finding out from local information and inspection what appears possible, giving instructions in writing on the spot to his surveyors and, in case of any surveys being made, arranging for permanent bench marks.

In this way in a few months a great deal of information and data would be acquired.

This should be compiled, printed if possible, and put on record in a systematic way, so as to be available at any time hereafter.

A great deal of money, time, and labour has often been wasted from want of this being done.

(11) Under the circumstances, considering how much good might possibly accrue to the Empire as well as to the Native States, I think it would be a wise policy if the Imperial Government bore all the initial cost of these investigations. If carried out economically, as suggested above, the whole cost would not be a large item.

(12) If any scheme is eventually carried out, the initial expenses incurred by the Imperial Government might be then recovered or be a first charge on the revenue derived.

MR. J. A. DEVENISH, State Engineer, Bhartpur.

(*Jaipur, 18th November 1901.*)

Mr. J. A. Devenish.

Note by witness on the use in Bhartpur of shallow reservoirs for temporary storage of flood water.

In flat country where sites for deep reservoirs are not obtainable, water may be stored temporarily for irrigation by the use of shallow basins formed by low banks built across wide drainage depressions. The drainage of these depressions and floods diverted from other catchment areas, discharge into the basins (locally termed "bunds") and are impounded in them to the full capacity of each, the surplus quantity received being allowed to escape by sluices or by byewashes into subsidiary basins; or, if these latter are not available, the escaped water can be diverted to saturate the neighbouring land where required.

2. In a typical case supposing that the longitudinal slope of the bed of a drainage depression averages 8 feet in a mile and that the width of it across is 1 mile, a bank 1 mile long, stretching across the dip and sufficiently high to retain an eight feet depth of water, is capable of submerging about half a square mile of country in front of it, and the basin, if it can be filled, is capable of retaining about 100 million cubic feet of water, more or less, according to its contour. With a rainfall of 30 inches between 5 and 10 square miles of catchment area would be required to shed enough water to fill it. Such a basin is by no means adapted to the prolonged storage of water, but under favourable conditions of climate and soil it may be of great benefit to agriculture when used for the temporary storage and distribution of floods. The loss of depth of retained water due to evaporation and percolation and absorption in the basin is not less than 8 feet per annum; and it is economical to empty the basin as soon as possible by means of sluices in order to flood land in rear. If the floods have been late and if the supply is ample, the basins may be nearly full at the end of the rainy season when the time comes to prepare the ground for the winter crop; if there have been no late floods, the basin may be nearly empty at that time. As soon as the ground surface of the bed becomes dry, either by natural exhaustion of the reservoir or by the emptying of its contents through sluice openings, the land that has been submerged in front of the bank will be found to be thoroughly saturated, softened, and fertilized, so that it is at once ready for the plough. The land that has been flooded in rear of the bank by means of sluices and distributary channels will also be softened for the plough and saturated sufficiently for the sowing of the *rabi*. It is important to note that the land in the bed of the tank or basin is by far more valuable than that in rear, because not only has the subsoil of the former been saturated, to which the roots of the crop penetrate, but also a layer of fine silt has been deposited on the surface; whereas the irrigation in rear does not saturate the subsoil or deposit much silt.

3. The crop sown in the bed of the tank is independent of subsequent watering in order to reach maturity. Moderate rain, indeed, assists the growth and increases the yield, and in years when the winter rains fail the growing crop is in some places watered from wells. Without such aid, however, it will remain healthy, deriving its nourishment from the moisture retained in the subsoil. The crop sown in the rear of the bank depends partly on a subsequent refreshment by winter rain or from wells, failing such assistance its yield is small.

4. The system of shallow reservoirs here described is suitable not only for the impounding of small local catchments, but also for the distribution of floods from large streams which may be diverted or led into the basins by means of feeder channels. If the latter source of supply be available, sluices are used to carry off the excess supply above the capacity of the reservoir, distributary channels from the sluices discharging into other basins or saturating the fields in rear. Under suitable conditions the main advantages of this system of shallow basins compared with deep storage reservoirs are—

(1) They are far more remunerative. The cost of construction is very much less. For low pressures of water earthen banks of slight section are sufficient. The use of masonry works is reduced to a minimum. The work is easy to design and construct.

Mr. J. A. Devenish.

(2) Dealing with low pressures the risk of damage is much less and damage is easily repairable if it occurs.

3. A much greater area of crop is obtained in proportion to the supply of water owing to the comparatively wide water-spread, in proportion to the cubic capacity.

(4) The bed of the tank is fully utilized for agriculture and becomes a much valued asset of the village, instead of compensation being paid for the loss of the land to the villagers.

(5) So much water is not exhausted unproductively by evaporation and absorption during prolonged storage as in deep reservoirs.

(6) The larger part of the crop is more valuable owing to the fully cultivated bed being fertilized by silt, whereas in deep reservoirs bed cultivation is usually discouraged and the silt deposit is consequently wasted. Crops irrigated by ducts during growth do not attain the yield of the bed crops. Even in years when the bed is not flooded it is cultivated, the enrichment of the soil being permanent.

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1. *Q.* (*The President.*)—You are State Engineer, Bhartpur?—Yes.

2. *Q.* Yours is not a State in which there are many storage tanks. I understand that there is only one such tank?—Yes, we have only one large storage tank. (In speaking of "storage tanks" the witness meant tanks adapted for prolonged storage, or storage after the sowing of the winter crop). Some of the Bhartpur *bunds* or tanks have shallow basins of large capacity, but the water is either exhausted naturally or let out purposely before the end of October. The storage is thus only temporary.

3. *Q.* The configuration of the country prevents storage?—Yes, there is no need for it. We have got irrigation facilities without storage.

4. *Q.* What are the irrigated and the cultivable areas of the State?—There were 82,000 acres irrigated last year from *bunds* or channels out of 767,000 acres of cultivated land in the State. 130,000 acres are assessed as irrigated by wells.

5. *Q.* (*Mr. Ibbetson.*)—The settlement report says 106,000 acres irrigated by wells?—Probably this means irrigated in one year.

6. *Q.* (*The President.*)—Were you in Bhartpur during the famine?—Yes, during the last two famines.

7. *Q.* What did irrigation do for you then?—It gave us a very fair area of irrigated crop. In 1899 we irrigated nearly 20,000 acres with the Ruparel water instead of the usual 30,000 acres and 53,000 acres in the whole State. The wells generally were not exhausted.

8. *Q.* How long do the cuts from the Banganga run?—Generally for 2, 3, or 4 days at a time as long as the floods last, which fluctuate with the rainfall. In a good year with recurring floods the cuts may run for a month continuously.

9. *Q.* Your tanks are now dry?—Yes. The water is used mainly for the sowing of the *rabi*. There is some irrigation below the *bunds* in addition to the land saturated in front. The amount remaining stored after the *rabi* sowing is very small. The great thing is to saturate the soil for the *rabi*, which is afterwards helped by the winter rains. Rain is not essential to the maturing of the crop. Where there are wells the crop may be additionally assisted. The principal feature of our irrigation is that the land is flat; the fall being not more than 5 feet in a mile, so a very low *bund* floods a large area.

10. *Q.* Have you any black cotton soil?—No.

11. *Q.* What height are your *bunds*?—About 12 feet. They are long and low following a contour. They are old works. They are supplied with sluices.

12. *Q.* Who maintains them?—They are repaired by the State.

13. *Q.* There is no *corvee*?—No.

14. *Q.* Could your rivers be bunded with advantage and used as reservoirs?—No; there is no suitable site. We can irrigate without this.

15. *Q.* (*Mr. Ibbetson*).—You say that there is no need for storing water because you can irrigate without it. Supposing you did store water, would you not get a much larger area?—No; it would not suit us at all. The most valuable land is above the *bunds*. The greater part of the water received is stored temporarily. For instance, one tank, the Bareta, is filled annually with 1,200 million cubic feet, the maximum depth being 8 feet, and the frontal water spread 14 square miles. By retaining the water in store after October the State would lose all the submerged land and would lose, moreover, the irrigation of a part of the large area in rear now flooded by the sluices before the *rabi* sowing, because gradual irrigation from store during the growth of the crop would not cover nearly so large an area as a rapid flooding. The full capacity of the latter is 1,500 million cubic feet and 250 million cubic feet are below the lowest sluice level.

16. *Q.* Is there any room for small works made by the people themselves?—The people have not the enterprise for it.

17. *Q.* You don't think they could be got to do it?—No. They are accustomed to the State doing everything for them.

18. *Q.* (*Mr. Higham.*)—The *bunds* really form distributing basins, not storage tanks?—Yes.

19. *Q.* You state that by the Sikri Bund you catch the whole supply and redistribute it; what is the effect on the *nala* below?—There is very little trace of a *nala*.

20. *Q.* Don't you ever get a big flood you cannot dispose of?—No. We have only once had one really large flood in my time and our sluices were sufficient to prevent a breach. Escaped water flows over the fields and is caught by subsidiary *bunds*.

21. *Q.* When you speak of the capital cost of your works, I suppose you mean the whole expenditure incurred, including annual repairs and everything except catchment?—Yes.

22. *Q.* How is the revenue derived? Is it fluctuating? Does it depend on the area actually cropped?—The revenue from *bunds* is mainly included in the settlement. The assessment is generally fixed, not fluctuating.

23. *Q.* Then what do you credit the works with?—There are no accounts to show the profits due to irrigation works. But I can show the assessments before and those after the construction of the works. The difference is mainly due to irrigation. The settlement officer considers that the increase in the revenue is about 5 lakhs of rupees.

24. *Q.* Do you charge water-rate?—Water-rate is charged on new works, where the land has not been assessed as irrigated or where the irrigation is fluctuating. The water-rate is Rs. 2-8 an acre.

25. *Q.* These figures show what you call capital cost has been at the rate of Rs. 12 per acre annually irrigated. Is that all it costs you?—That does not include the establishment for one thing. The total expenditure during the last six years on the works, excluding establishment, is about Rs. 12 an acre annually irrigated. This does not include cost of abandoned works subsequently restored.

26. *Q.* This irrigation is remarkably cheap?—Yes, it is.

(Witness shows statement of Bareta Bund and explains that cultivation from the tank has not been fully developed. Three hundred million cubic feet are below the sluice level. There is no land below this, and leaving this part does away with need for refilling at commencement of next year's flood.)

27. *Q.* (*Mr. Ibbetson.*)—You say that the profit is equal to the amount of revenue now got *minus* the revenue before the works were made. I don't quite understand about the works being made. I thought they were all old works. When were they restored?—Within the last six years. In addition to these old works there are a number of new works, principally inundation canals, to which more than a third of the irrigated area is due.

28. *Q.* You mean practically revenue before that restoration a few years ago?—Yes.

(Witness informed the Commission that, with reference to the Ruparel scheme, there would be no objection to Alwar using the whole cold weather supply as proposed by Mr. MacDonald.)

MIR MOHAMMUD HOSSEIN, Deputy Collector, Bhartpur.

(*Jaipur, 18th November 1901*)

Mir Mohammud Hossein.

In reply to *Mr. Ibbetson*, witness said—I have been employed in the Bhartpur State during the past seven years. 145,652 acres are assessed as irrigated from *bunds*. A water-rate is assessed on all dry lands which are irrigated. The State

Mir Mohammud Hossein.

has imposed a charge of Re. 1 per *bigha* within and 8 annas per *bigha* outside the *bunds* for all new land irrigated. On the Bareta *Bund* the charges are according to the crop, *viz.*, sugarcane, Rs. 2-8-0; *makka* and rice, cotton, and zira, Rs. 2; juar, Re. 1; opium, Rs. 2-8-0; wheat and barley, Rs. 2; *bejhar*, Rs. 1-8-0; and gram, Re. 1 per *bigha*. A *bigha* is $\frac{5}{8}$ of an acre. I have not calculated the profits on the Bareta Bund, but I think that the whole cost will be recovered in 15 years. There is no doubt about the profit from irrigation works. They have raised the land revenue of the State during the past six years by 2½ lakhs, besides giving Rs. 40,000 in annual water-rate. It is calculated for one year, but will vary from year to year according to the area irrigated. In shallow wells the water is sweet; deeper down it becomes bitter. *Kachcha* wells are therefore preferred to masonry wells. Rupees 98,047 were given as *takavi* in the 8 years before the settlement of the land revenue; and in the two years succeeding the settlement, about one lakh. If a well is made even a year before the settlement, the land is assessed wet; but the fact that a well is new is considered in distributing the amount of the settlement (*tafriq*). If a well falls down altogether, the assessment is taken off in a new *tafriq* made every five years owing to the change in irrigated condition of land. Sometimes the zamindars stop the working of their wells just before the settlement, but the area has been assessed as *chahi* during the settlement.

2. Previously *takavi* was given through the lambardars. Now it is given direct to the cultivator. *Takavi* is taken readily in Bhartpur. Recovery is postponed for two years and is then made in three years; no interest is charged.

3. The *ryasat* year begins in September; formerly it was in April. The water of the wells is brackish; but when the floods come the spring level rises and the *rabi* is sown, germinates, and is ready for irrigation from the brackish wells. The floods do not sweeten the wells much; the bitter water of the wells causes *reh* which is washed away by the floods. There are in all 11,494 masonry wells in the State; of these 6,823 yield sweet water. There are besides 6,665 *kachcha* wells, of which about 2,000 are not worked. There are plenty of places for new wells, but the people are afraid of the bitter water.

RAI BAHADUR SHYAM SUNDER LAL, Dewan of Kishengarh.

(*Jaipur, 19th November 1901.*)

Rai Bahadur Shyam Sunder Lal.

Witness put in the following documents:—

KISHENGARH STATE.

General Report.

The Kishengarh territory consists of a narrow strip of land 82 miles long extending from the southern banks of the Sambhar Lake in the north to the Khari river within a few miles of Deoli in the south. The breadth of the State from west to east varies from 20 miles in the central portion to from 7 to 10 miles at its ends.

The territory is situated between north latitude 26° 17′ and 26° 59′ and E. long. 74° 43′ and 75° 13′.

The northern portion is partially sandy owing to the drifts of sand from the adjoining Marwar district in the west. The central portion has poor soil overlying stratified rocks in the north and gneiss in the southern half.

The southern portion has good rich soil which partakes of the nature of the Harowti soil overlying gneiss.

The State is crossed by rivers which enter it from the west side and generally take an easterly course inclining a little to the north (and falling into the Sambhar Lake) in the northern part (Rupnagar district) and to the south in the central and southern portions eventually falling into the tributaries of the Banas.

The State is bounded on the north by the Sambhar Lake, on the west by the Jodhpur State and Ajmer, and on the south by Shahpura (Udaipur) and on the east by Jaipur and Ajmer.

The rivers don't run all the year round. In fact, they are mere nullahs that are for a few hours in flood whenever there is a good shower of rain, and flow off and on during the monsoon season.

(*a*) The total area of the State is 858 square miles.

(*b*) The population of the State according to the census of 1891 was 125,000 persons, and according to the last census it was only 91,000. It may, however, now be safely taken at 115,000 persons owing to the return home of the emigrants.

(*c*) The total number of villages in the State is 231, of which 65 are *khalsa* or crown land and 166 are alienated or *jagir*.

(*d*) The average land revenue of the State is Rs. 2,05,000.

In ordinary years it is Rs. 2,75,000.

In famine year 1899-1900 it was Rs. 58,000 only.

(*e*) The average area cultivated irrigated both in *kharif* and *rabi* by existing tanks is 42,000 *bighas*, by the bigger tank 12,000 *bighas*, by small *kachcha* tanks 54,000 *bighas*=21,600 acres—

1 hath=2 ft.

1 bigha=66 haths square.

=$\frac{1}{10}$ of an acre.

1 bigha=$\frac{2}{5}$ acre.

Area irrigated by wells—

=65,000 bighas.

=26,000 acres.

Out of the above nearly a third of (1) and $\frac{1}{5}$ of (2) represents cotton and other non-food grain crops, the rest being food-grain crops.

(*f*) The average annual food-grain produce of the State is 900,000 maunds, of which about 8 lakh maunds is required for local consumption taking it at 7 maunds per head.

(*g*) The approximate number of persons for whom work has to be found for relief in famine is 10,000. The proposed works would employ 21,000 persons daily for 3 months; of these proposed works, four are situated within the catchment area of the Sambhar Lake, *i.e.*, in the Rupnagar district.

(*h*) The average rainfall for the eight years preceding the last famine year is 20 inches as given on the margin.

Years.		Inches.
1891-92	. .	7·68
1892-93	. .	36·33
1893-94	. .	32·39
1894-95	. .	21·40
1895-96	. .	19·45
1896-97	. .	18·10
1897-98	. .	19·40
1898-99	. .	8·32
1899-1900	. .	4·58
1900-01	. .	21·98

That for the famine year 1899-1900 was 4·58 inches only. The rainfall for 1900-01 was 21·98 inches.

(*i*) The district has suffered from four severe famines and three years of scarcity during the last 32 years. But the last eight years with the solitary exception of the year 1891 have been years of short rainfall and poor harvest.

(*k*) The total number of tanks is 165, of which 112 have catchment up to 2 square miles, 37 have catchment of 2 to 5 square miles, 16 from 5 to 10 square miles, and four above 10 square miles There are besides over 1,000 small *kachcha* (earthwork) *bunds* or storage tanks which have each a catchment of less than half a square mile generally owned by cultivators. The total catchment areas, the run-off of which is thus secured for storage, is over 500 square miles.

(*l*) The total number of wells, including *jagir* and *khalsa* in the State, is 10,573, of which over two-thirds are in constant use, while the remaining third have fallen into disuse principally on account of the failure of supply of water in them during the last few years of successive deficiency of rainfall and also to a certain extent on account of the water in them being hard and surcharged with sulphate of sodium, which renders the soil unfit for unintercepted cultivation.

Rai Bahadur Shyam Sunder Lal.

The number of wells in each district is as follows :—

District.	Wells in use.	Wells out of use.	Total number of wells.	Food grain; total produce.			Irrigated area per well, and average in acres.
				Kharif.	Rabi.	Total maunds.	
(1) Kishengarh	1,387	872	2,259	20,000	98,000	118,000	3
(2) Rupnagar	1,047	783	1,830	24,000	124,000	148,000	7
(3) Sarwar	1,234	616	1,850	25,000	111,000	136,000	3½
(4) Arnia	1,299	839	2,138	26,000	91,000	117,000	3
(5) Bandersendri	535	376	911	12,000	39,000	51,000	3½
(6) Thikanas (bigger nobles' estates) .	1,100	483	1,583	20,000	88,000	108,000	4
Total .	6,602	3,969	10,571	127,000	551,000	678,000	in normal years.

The area irrigated from the wells—

(*a*) in normal years is 26,000 acres.

(*b*) in the famine year is 9,000 acres, *i.e.*, a third of the normal area due to failure of water in wells.

(*m*) The northern portion, that is, the Rupnagar district which falls within the catchment of the Sambhar Lake, used to have the best and most plentiful supply of water in wells and consequently the average acreage per well in the district used to be 12 acres, which is double or triple the area per well in other parts.

Thus it was in this district, unlike all the rest, that storage tanks were the least needed on account of the successive failure of rains and the bunding of rivers higher up at different places; the wells have been failing thereby, pointing to the bunding of rivers within local limits, as the only means of restoring percolation in wells.

In the other portions, it will be seen that from time to time no effort has been spared in storing the rainfall over the Kishengarh territory, as would appear from the series of dams and weirs that have been constructed across almost every stream or nullah from place to place in its course. The total catchment area thus secured for artificial irrigation or protective purposes is two-thirds of the total area of the State and is made up as follows :—

	358	Square miles for bigger irrigation works.
	200	Square miles for the thousand and odd smaller *kachcha* storage works.
Total .	558	

The proposed new works are now calculated to add 115 square miles to the catchment area already secured for irrigation (both direct and indirect) which would thus go to make a total of 673 square miles, against 858 square miles the total area of the State. A copy of the Kishengarh map showing all the irrigation works is appended.

General remarks.

The proposed storage works as well as those already in existence are of great use in ordinary years; but they fail in years of drought or scanty rainfall (when they would be the most needed), as the sources of their supply are mere rainy season nullahs or surface drainage and not perennial streams. The bigger rivers, like the Khari, the Banas, the Chambal, would appear to be free from this objection, but as conservation of their flood water or ordinary flow would entail interstatal difficulties and necessitate combined action both as regards the selection and carrying out of schemes and raising the necessary capital. The Kishengarh Durbar would be happy to join any such scheme. The Durbar would, for instance, be happy to join a scheme for diverting a portion of the flow of the Khari river, by means of cuts which has been suggested among proposed works.

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1. *Q.* (*The President.*)—You are Dewan of Kishengarh?—Yes, I have been so for 16 years.

2 *Q.* You were a member of the last Famine Commission and can talk from experience of other places besides your own State?—Yes.

3. *Q.* You say there have been bad times in your State for a number of years?—Yes.

4. *Q.* The southern part of the State is the richest?—Yes.

5. *Q.* You say you have 22,000 acres irrigated from tanks and 26,000 from wells?—Yes.

6. *Q.* There is a large quantity of cotton grown?—Yes.

7. *Q.* Did the State suffer much during the last famine?—Yes, very much; out of a population of 125,000, as many as 16,000 were on relief works; about one-fourth of the people emigrated, but they are now returning.

8. *Q.* Have any objections been raised to your works on account of interference with the Sambhar Lake?—Yes; all the important works on our list have been objected to on this account. The State is a narrow strip running from north to south and all the rivers run from east to west, so that we can practically do nothing in the way of irrigation without questions being raised by other States; and works constructed to the west interfere with our supply. We want to hold up water chiefly with the object of restoring wells by percolation, but also direct irrigation. There are very fine wells in the State.

9. *Q.* How deep are the wells?—About 60′ now; 40 to 50′ formerly; 60′ is not considered a great depth for wells. We use them for irrigation up to 90′.

10. *Q.* What crops do they irrigate?—*Makka* and cotton in the *kharif.* Wheat, barley, and caraway-seed in the *rabi.* The loss of percolation water owing to the construction of *bunds* by Ajmer has lowered the depth of water in the wells in Rupnagar from 42′ to 60″. This has reduced the average irrigation per well from 12 to 7 acres. It seems hard that we also should not be allowed to make dams; without them we can do nothing.

11. *Q.* Are there many small tanks?—Yes, a large number. They irrigate from 5 to 20 or 30 acres each.

12. *Q.* Are advances given for wells?—Yes.

13. *Q.* Are they availed of to a large extent?—No. There are two systems of encouraging well construction; *viz.*, *takavi* and concessions of revenue demand For new

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wells we take $\frac{1}{10}$ of the produce during the first year, $\frac{1}{9}$ in the second year, and so on, until we come down to the usual $\frac{1}{3}$rd; we find this is a sufficient inducement.

14. *Q.* What is the cost of a well?—It differs. In Rupnagar it is about Rs. 300. In the central and southern portions it is much greater.

15. *Q.* Do you charge interest for the advance?—We charge 6 per cent. to cover failures which are numerous especially in the trap.

16. *Q.* Is the water ever salt?—The water is not salt; but it is sometimes very hard and useless for irrigation.

17. *Q.* (*Mr. Ibbetson.*)—You remit the whole in that case?—We remit the whole and cover the loss from the interest derived from other wells; we find that a great encouragement.

18. *Q.* Have you ever employed professional well-borers?—Yes. Borers serve a very good purpose up to a certain depth. They use tools made in the country.

19. *Q.* Do they belong to the Durbar?—Yes.

20. *Q.* Why are they not used beyond a certain depth?—Because the tools are not very skilfully made.

21. *Q.* It is the fault of the tools?—Yes.

22. *Q.* Would a zamindar who wished to make a well get a boring taken first?—No; boring commences when a well has been sunk to tap the spring.

23. *Q.* You don't bore first to ascertain the quality of the water and its depth?—No; I have been thinking of doing so. We always promise to refund the cost in case of a failure.

24. *Q.* (*The President.*)—Is the practice in force of putting *bunds* round the fields in order to retain the water and let it soak in for the *rabi* sowing?—*Bunds* are only made round the more valuable fields where water is scanty. By this means grain is sown even if there is very little rainfall.

25. *Q.* Has the Khari project been thoroughly examined?—Not yet. It should be taken up jointly by the three States concerned, with Government aid.

26. *Q.* (*Mr Higham.*)—What is the fall in the water-level of wells in the Rupnagar district?—10′ to 12′. The fall has not been quite as much in other tracts. It is due partly to the construction of the Kair tank in Ajmer and the construction of other *bunds* both in Ajmer and our own State; there are many small *bunds* and some large ones all along the streams in our own State as well as in Ajmer, and these have lessened the water. The fall has been going on for eight years. With a good rainfall there was no effect. The rainfall has been deficient for the past 14 years except in 1892, but this is not the only cause of the fall in spring-level. The *bund* at Kair in Ajmer cuts off all the water, and there is no flow below it. What we want to do is to make a *bund* at Singla in the Rupnagar valley to collect the local rainfall so as to assist our wells by percolation.

27. *Q.* There are, you say, a large number of *kachcha* works made by private individuals?—Yes; over 1,200 small works of this kind.

28. *Q.* Is there any room for extending them?—We have already utilized about $\frac{2}{3}$ of our available catchment in this way. They cost Rs. 200 to Rs. 2,000. The State gives concessions and *takavi* if asked for. The *takavi* is sometimes replaced by guaranteed loans, the lender having a first lien on the property. Our tank-irrigated area is far greater than our dry-cultivation area.

29. *Q.* (*Mr. Rajaratna Mudaliar.*)—You say remissions are granted when the wells fail. What remissions have been given in the past 10 years?—I cannot say how much has been remitted for failure of wells; but the failures amount to 4 or 5 per cent.

30. *Q.* How much has been given out as *takavi*?—In the year before last we gave out Rs. 37,000 *takavi* for sinking and deepening of wells. Last year the rainfall was good and demand for *takavi* small; this year we will give Rs. 35,000. I cannot give the figures for the last 10 years, but the average is about Rs. 20,000 a year; that is, besides the guaranteed loans.

31. *Q.* You mention Agricultural Companies; what are they?—Companies who advance money for agricultural works and take $\frac{1}{4}$ or $\frac{1}{3}$ of the revenue in lieu of interest until the advance is paid. This amounts to much more than 6 per cent. This system is chiefly adopted in *jagir* villages held by a number of petty *jagirdars*. *Jagir* forms about two-thirds of the State. The State guarantees the payment of a moiety of the revenue in lieu of interest. The Company is subsidised by the State for further improvements. For large works we advance to *jagirs* at 6 per cent.

32. *Q.* Have the objections regarding the Sambhar been brought to the notice of the Government of India?—They have come from the Government of India.

33. *Q.* (*Mr. Ibbetson*).—For how many years have these Agricultural Companies been formed?—About six years.

34. *Q.* Who are the members?—Mostly local people.

35. *Q* Chiefly officials and money-lenders?—No.

36. *Q.* Who started the movements?—I did. Agricultural Company is a registered company consisting of *jagirdars*, bankers, and local officials.

37. *Q.* What is their security?—The security is the profit of their investment.

38. *Q.* Does it pay them well?—Yes. For instance, the Jubilee Sagar pays about 14 per cent. From the State we get money at 6 per cent. and advance at 9 per cent.

39. *Q.* Do you think the movement will continue on its own motion?—No. For some years to come the movement will require my fostering care. Great difficulty was experienced in overcoming the diffidence of the *bohras* or local bankers. Now they have come to see that the State recognises their rights.

40. *Q.* Has anything been attempted in the form of co-operative associations; that is, not for profit, but for mutual assistance?—We have agricultural banks which borrow money from *bohras* or failing them from the State.

41. *Q.* I suppose they divide no profit?—No. The profit goes to the reserve fund.

42. *Q.* Is that movement spreading?—Yes; it is only two years old.

43. *Q.* Do you think it is going to be a success?—Yes. To get a few people out of a village to form a company is not practicable. But I find in existence a very compact village community. They have already several interests in common managed by a *panchayat*; for instance, they manage the village funds. I have utilised these *panchayats* and consolidated them into a company and they borrow money at a reduced rate of interest which they give to persons of good character. The result of the *bohra* lending to the *panchayat* is that the *panchayat* pays 9 per cent. or even in some cases 6 per cent. instead of 18. Then it has safer security. The *bohras* have the first lien on the *panchayat* and are in some cases now competing with each other.

44. *Q.* Is any pressure put upon the *bohras*?—No.

45. *Q.* The security which the *panchayat* gives is a personal security?—Yes; but they have power to levy any tax among themselves. The *panchayat* represents the community who are all responsible.

46. *Q.* So that they really pledge the village revenues?—No; the cultivator's share of the produce.

47. *Q.* How can they pledge this?—The *panchayat* advances money to approved cultivators on the security of their assets, and is empowered to realise its advances by attachment and sale of their respective shares of the produce without having to go to the Civil Court. The *panchayat* borrows its working capital from a banker or from the State; and if its transactions with the cultivators result in a loss, the *panchayat* makes good that loss by levying tax among the people, along with other commercial taxes once a year.

48. *Q.* In regard to this Rupnagar question, you attribute the fall in the subsoil water to two causes: recent drought and the construction of *bunds*. I suppose that in the course of time the effect of drought should disappear, so that really as a matter of permanency all you have to consider is the *bunds*?—If they were removed, your wells would recover their normal condition?—Yes.

49. *Q.* What does a well 90′ deep cost?—Rs. 1,000 if blasting is involved.

50. *Q.* How many acres would that irrigate?—About 5 acres or 15 *bighas* each year.

51. *Q.* Is it worth while to dig a well costing Rs. 1,000 which irrigates only 5 acres?—Yes.

52. *Q.* The crops must be very valuable. What are they?—Cotton is the crop the cultivators like to grow, but will bring pressure to make them irrigate wheat and barley.

53. *Q.* What is the area of a *bigha*?—Half of an acre approximately. Our theoretical *bigha* is 132′ square. The practical *bigha* is $\frac{1}{3}$ of an acre.

Rai Bahadur Shyam SunderLal.

54. Is the area irrigated by these wells largely reduced in a famine year?—Yes, very largely reduced. Diminished in fact by ⅔rds.

55. *Q.* So that your 5-acre well would, in a famine year, irrigate about 1½ acres?—No; more than 1½ acres. The reduction of water is greater in higher level and less in the lower. These wells are a real protection against famine. The holdings are small and well manured.

56. *Q.* At any rate the protection against famine would be small, seeing that the crop grown is cotton and the area is very much diminished?—They don't grow cotton in a famine year.

57. *Q.* You mean that the cotton fails and they have to sow something else. Is not cotton sown long before they know what the rains are going to be like?—It is generally sown in the *chhota barsat* or early monsoon. The wells are a very good insurance against famine.

58. *Q.* You mean they make the people prosperous and better able to resist famine?—Yes.

59. *Q.* Since the State bears the cost of a well which fails, the people do not mind about the risk of failure. This seems to me to be always a danger; could you not guard against it?—The site is generally approved by the village revenue authorities before the advance is given for a well. The *panchayat* considers the site. They even consult an opposite faction, if necessary.

60. *Q.* Do you think a test boring would be a greater security? - Yes; I am thinking of trying it.

61. *Q.* You grow a great deal of cotton in the State. Is there any black cotton soil?—A little in the southern part.

62. *Q.* Do the people irrigate it freely?—Yes, both in *kharif* and *rabi,* and it requires less water than sandy soil.

63. *Q.* I understood that owing to cracks in the soil you could not irrigate black cotton soil with small quantities of water. Are you speaking of irrigation from wells?—No. Irrigation from tanks. They make very small *kyaries.*

64. *Q.* (*Mr. Higham.*)—When do they take the water?—Whenever they want it. They require most water in the sandy and lighter soil.

65. *Q.* What crops are grown on the black cotton soil?—Cotton and *makka.*

66. *Q.* When do they sow the cotton?—They sow cotton on the well-irrigated land early in May and on tank lands a little later.

67. *Q.* Why do you charge more for black cotton soil?—We don't.

68. *Q.* Looking at the table I see that both your tanks, and well irrigation has increased since the good year of 1897-98?—Yes. Sixteen inches of rain is generally sufficient for our requirements if we have timely showers.

69. *Q.* Your well area has also increased?—Yes. We have added 12 per cent. to the number of wells during the past 12 years.

70. *Q.* (*Mr. Rajaratna Mudaliar.*)—Does the black cotton soil crack during the hot weather?—Yes. It is not the black cotton soil of the Central Provinces. It more resembles that of Kotah, Jhalawar, and Malwa.

MR. MANNERS-SMITH, Superintending Engineer, on special duty.

(*Jaipur, 19th November 1901.*)

Mr. Manners-Smith.

1. *Q.* (*The President.*)—You have been deputed to study the improvements in irrigation possible in Native States?—Yes, to assist those States which have no Engineer of their own in preparing information for the Commission.

2. *Q.* Of these Kishengarh is one?—Yes.

3. *Q.* Have you much hope as regards the Khari river project?—The Khari river project was thought of for Ajmer in 1884. The head-works of the canal were to be at Garwar in Meywar territory. The Meywar Durbar objected. Afterwards Meywar (Mr. Monkton being State Engineer) prepared a project of their own for the Khari. Two States—Meywar and Shahpura—and Ajmer have proposed projects for this river. The idea for Ajmer was to take out a canal and fill a series of existing tanks.

4. *Q.* Is it a river in which you can store water?—There is no place for storage in the river itself. Down below the bed is very sandy.

5. *Q.* Is it deep below the surface?—In some places the banks of the river are fairly deep.

6. *Q.* Have you gone into the question of the claims of the Salt Department?—I was put on special duty in connection with the Salt Lake question. It arose originally during the late famine. Ajmer was building the Ontra Tank as a famine relief work, and the Salt Commissioner objected to its being made. Finally, the Government of India stopped our going on with the work. Since that, in April last, Mr. Dane wrote to the Government of India not only objecting to the construction of new tanks, but also suggesting the removal of existing tanks. The Government of India has ordered us to take observations of discharges of the river for a series of years to observe the effect of rainfall in the catchment. They also asked for opinion on Mr. Dane's proposals and have laid down a rule that no new works or improvements to tanks are to be made without consulting the Commissioner of Salt Revenue. My Superintending Engineer has asked me to bring up this case as showing the difficulties of extending irrigation in Kishengarh and Ajmer. (*Witness shows statement of discharges.*) These discharges were taken partly by Kishengarh, partly by the Public Works Department, and partly by the Salt Department, and are perhaps not altogether reliable. One discharge shows that you lose ¾ths of the discharge in 16 miles, with rainfall up to 1¾ inches throughout catchment. Mr. Dane contends that with heavy rain in Ajmer the rain reaches Sambhar Lake. If you have more than 2 feet 6 inches of water in the lake, it delays the manufacture of salt.

7. *Q.* (*Mr. Higham.*)—What is the general conclusion you have come to?—My conclusion is that if there is rain in Ajmer and none below, moderate floods would never reach Sambhar, and if heavy floods, only a small portion.

8. *Q.* Are there any other works in Kishengarh which you think feasible?—Kishengarh has taken advantage of nearly every site available. There are four possible sites, three of which are in the catchment of Sambhar; one very good one at Manpura.

9. *Q.* Is that one of those objected to?—Yes.

10. *Q.* As regards this river Khari, is Garwar undoubtedly the best site? Have you had a chance of examining it?—No; but it has been examined by numerous Engineers and they have all settled on that one site.

RAO BAHADUR SHAM NATH, Executive Engineer, Ajmer Provincial Division.

(*Jaipur, 22nd November 1901.*)

Rao Bahadur Sham Nath.

1. *Q.* (*The President.*)—You are Executive Engineer of Ajmer and Merwara?—Yes.

2. *Q.* Are all the works under your charge?—Yes.

3. *Q.* Have you had charge long?—I have been in charge of this division four different times for about three years in all.

4. *Q.* Are you a Roorkee man?—Yes.

5. *Q.* Have you studied any projects for irrigation works in Ajmer? Do you know anything about the proposals for utilising rivers like the Banas?—I mention the Khari scheme in my statement; it affects the *Istimrar* Estates.

6. *Q.* Your relief works were chiefly tanks?—Yes.

7. *Q.* Were sluices built in these tanks?—Yes.

8. *Q.* In every case?—Yes.

9. *Q.* That was not done from the famine fund, I suppose?—Yes; from famine fund.

10. *Q.* Can you tell me what proportion of the cultivable land of Ajmer district is irrigated or covered by irrigation?—The total irrigated area in Ajmer and Merwara is 58,079 acres.

11. *Q.* What is the total cultivable area in these two districts?—The total area of the province is 734,578 acres.

12. *Q.* You have not got the cultivable area?—No. The revenue part of this report was done by the Revenue Department, and anything that refers to revenue I know nothing about.

Rao Bahadur Sham Nath.

13. *Q.* Are you keeping up a programme of famine works?—Yes.

14. *Q.* How many people do you provide for?—The programme which has been got out provides for 80,846 people for the two districts.

15. *Q.* For how many months?—Three.

16. *Q.* You talk about 1st, 2nd, 3rd, and 4th class tanks. What do you mean?—For assessment purposes the tanks have been divided into four classes:—

Class I.—Those in which the irrigated area pays either a crop rate, varying as the crop shown or a special contract rate settled by agreement in lieu of the same.

Class II.—Those in which a standard area and a standard revenue have been fixed, and under which the land pays a rate which, within defined limits, varies in proportion to the area on which crops are irrigated or brought to maturity, and (when the supply for the spring crop runs short) as the number of waterings given to the field.

Class III.—Those paying an assessment fixed for a period of years and which are maintained by Government.

Class IV.—Those paying an assessment fixed for a number of years and which are repaired by the villagers.

17. *Q.* Have you any new tanks proposed for Ajmer?—No. You will see from the map that the whole catchment of both districts (Ajmer and Merwara) has been utilized.

18. *Q.* You cannot find any new sites for tanks either in Ajmer or Merwara?—No.

19. *Q.* What tanks have you got in the famine programme?—Improving and strengthening the dams of existing tanks.

20. *Q.* Do you ever employ famine labour on anything except on earthwork?—Sometimes on dry stone masonry walls and also on concrete.

21. *Q.* Do they make a concrete wall throughout, or do they employ other labour?—Solely by famine labour.

22. *Q.* You say in this statement that a certain quantity of water is left in a tank. Is that below or above the sluice level?—Below it.

23. *Q.* You don't empty the tanks every year?—In good years some water remains; but in others there is no water, which is very scanty here.

24. *Q.* I suppose your tanks don't fill in a bad year?—No. In a year of ordinary rainfall they fill with some exceptions.

25. *Q.* Have any of your tanks got water now?—Hardly any. There is a little in a few tanks. There is some water in the tanks in Merwara now; but generally at this time they are all empty.

26. *Q.* (*Mr. Ibbetson.*)—Have any tanks been made during the last ten years in Ajmer?—Yes.

27. *Q.* How many new tanks have been made?—28 in both districts, *viz.*, 8 in Ajmer and 20 in Merwara.

28. *Q.* Do you keep up a return of the income derived?—The Revenue Department keeps that.

Mr. E. O. Mawson.

MR. E. O. MAWSON, Executive Engineer.

(*Rajkot, 29th November 1901.*)

(*Replies to printed question.*)

General.

The following notes refer to Kathiawar, more particularly to the central portion of the district. I served in Kathiawar for 2¼ years as Agency Engineer and had ample opportunities of becoming acquainted with the district, especially during the late famine. The rainfall varies considerably, being about 80 inches near the Girnar Hills and about 22 inches in the north-east; but, excepting the small area with high hills, the average rainfall over the whole district is from 22 to 27 inches per annum. In the famine year the rainfall was only about 5 inches, while in the following year it was nearly 40 inches. The chief obstacles to the extension of irrigation are the lack of capital for initial expenditure and the fear of enhanced revenue assessment; the latter being due to the fact that irrigation from tanks has only been recently introduced, will probably soon vanish, but the lack of capital will remain a permanent obstacle. The soil is as a rule good, and, over large tracts, excellent. There is a temporary dearth of cattle due to the great mortality during the late famine, but a few years will remedy this. During the short time irrigation has been introduced into Kathiawar there has been no sign of injury to the remaining cultivation; the area so far irrigated is so small that this question would not arise for many years even if the irrigated area was increased ten-fold. There are no canals with continuous flow, nor are there any parts of the district where such canals could be constructed. The only intermittent flow canals are small irrigation channels deriving their supply from streams temporarily bunded by very small earthen dams. These dams are washed away every rains and re-made year by year. Such channels are rare and can only be constructed in a few favourable situations, because in Kathiawar, owing to the soft and friable nature of the upper layers of the *muram* immediately underlying the soil, the beds of the streams are generally from 10 to 15 feet below the surface by the time the nullah has attained a sufficient length to have a discharge suitable for irrigation. These small intermittent channels are entirely managed by the rayats; as a rule, the supply is maintained long enough in the cold weather to permit of wheat or barley crops being grown. Such irrigation may be taken to increase the net return due to the produce of the land by about one-half in a year of either ample or average rainfall, as however ample the flow it will go to waste after the cold-weather crop is reaped. In a year of drought there would be no water so near the source as these works are now situated. There is no fixed charge per acre irrigated, as these works being in Native States the recovery is by share of crop.

Tanks.

The tanks in Kathiawar are all formed by *bunds* of masonry or earthwork thrown across rivers, and they are supplied with water by the run-off from the catchment area during the monsoon. The water is distributed to the land by canals, from which small channels are taken off at intervals; these channels again branching as required by the nature of the ground. Irrigation has only been started in Kathiawar, and the tanks are designed to irrigate cold-weather crops in years of average rainfall, or to protect the rain crops in years of scanty rainfall. In average years no water would be required during the monsoon, and the hot weather and perennial crops will be so small as to be a negligible quantity. The irrigation increases the value of the produce of the land by the substitution of more for less valuable crops in years of ample rainfall and by preserving the rain crop and thereby increasing the yield in years of scanty rainfall. In ordinary years the irrigation is not supplemented by wells, but in years of drought wells would be used. During the late famine, when the water in the Lalpuri Tank (then the only irrigation work) was nearly exhausted, all the old wells were used to supplement the tank supply. Owing to the ground being saturated by the two previous years' irrigation, the wells were, due to percolation, in a much better condition than previously. The subsoil water level had risen and the wells held out to the end of the famine. In the case of the Lalpuri Tank the rate per acre varies from Rs. 5 to Rs. 11 per acre for water rate according to the class of soil. The cultivator may grow what, and as many, crops per annum as he likes. On all the new tanks constructed during the famine the rates have been fixed according to the crop grown. At Lalpuri the rate is paid on the irrigable area to which water is supplied; on all new works the rate is charged only for the crop and area actually cultivated and irrigated. The private expenditure to bring the water on to the land is practically *nil*. All the cultivator has to do is to make the small distributing channels, and this is part of his ordinary field labour. The annual average rate per acre for water amounts to about Rs. 4-8 to Rs. 5-8 according to the situation and soil. In the Thanas this rate is fixed for each crop in cash. In independent States the water-rate is taken in an enhanced share of crop. But all round it comes to about Rs. 5 per acre. This rate is nearly always levied on the actual area irrigated. The irrigable land in Kathiawar is as a rule nearly level, and there is practically no expenditure required in preparation for irrigation except the small cost of constructing the *dorias*. The main expense of the canal falls to the landlord; the small labour of making the *dorias* on the rayat. There is practically

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very little silt clearance or repairs necessary. For the main canals this falls on the landlord; while on the small *dorias* it will form part of the ordinary field work of the cultivator. In all independent States the Chiefs make such regulations as they deem proper for the distribution of water and realisation of revenue. Irrigation in Kathiawar is in its infancy, but I have never heard of a case of a cultivator appealing against his assessment in independent States. Up to the present famine has been almost unknown in Kathiawar. Government assistance is *urgently needed* to bring into full operation the works partially constructed during the late famine, both in the Thanas and small States. No legislation appears necessary; what is wanted is *funds* to complete the works already nearly finished so as to make them remunerative. There are very many sites at which remunerative and protective tanks could be constructed; but the lesser Chiefs and landholders are very poor, and without Government aid nothing can be done. As regards the silting of tanks, there is no precedent to quote except the small tank at Randerda near Rajkot. This tank has hardly silted at all. Judging from the water brought down by nullahs and streams in flood, there does not appear to be any fear of excessive silting.

Allowing for the difference in level between the bed of the bunded stream and the outlet, it is probable that the tanks will not silt up to outlet level for at least three generations, even if then. Except in occasional and very heavy rains very little debris is carried down by the rivers; and, so far as Kathiawar is concerned, the silting up of the tanks may be left out of the question when estimating their value either as paying irrigation or protective works. The country is admirably adapted for small irrigation tanks, as it consists of bare *muram* hills with good black soil valleys. The *muram* hills give excellent sites for reservoirs, while the valleys, nearly level, offer exceptional opportunities for distributing the water. The one item necessary is funds to carry out suitable works. In Kathiawar the staple crop irrigated is wheat, while the principal rain crop grown without irrigation is *juari* and in poor soil *bajri*. The effect of irrigation is to convert the *juari* cultivation into wheat crops. The net profit per acre to the rayat, after paying revenue assessment or *rajbhag* and allowing for all out-going expenses, is from Rs. 7 to Rs. 10 per acre, while the net return on irrigated crops averages about Rs. 20 per acre.

WELLS.

The average depth of wells used for irrigation is about 35 feet. In the north-east of the district at Wadhwan and near the Ran of Cutch the wells are brackish, especially in years of scanty rainfall. In the rest of the district the wells are sweet and there is a considerable amount of well irrigation. The cost of construction varies very much. A good well 30 feet deep, the top 10 feet of which would have to be built up with masonry, would cost about Rs. 2,000; but there are many wells, where the *muram* is near the surface, which have not cost more than Rs. 400 to Rs. 700, including all apparatus for drawing water. Beneath the black soil the whole district consists of porous *muram*, and the supply to the wells is by percolation. Thus all irrigation wells are situated in the flat land between two ranges of rising ground. A well once dug practically lasts for over; the only repair necessary is for the top masonry. The water is always raised by *mot*. The area irrigated from each well varies from 2 to 10 acres and the land commanded is, approximately double these figures. Well-irrigation practically doubles the value of the produce of the land by leading to the substitution of wheat or barley for *juari* and *bajri*. In years of drought the water level sinks considerably, but the extra labour in raising the water is compensated for by the increased value of the grain and also by the value of the stalk as fodder, which as a rule is not taken into account in ordinary years. On well-irrigation there is no special rate. The Durbar gains equally with the rayat owing to the revenue being as a rule collected in kind. Each State has its own rules as to the share taken by the Durbar from well-irrigation, and these shares vary with the manner in which the well was constructed, *i.e.*, whether the cost was met by the State, by the rayat, or by combination. Temporary wells were dug during the recent famine, but they were not very successful. They are not much protection against drought, as by the time the well is sunk it is too late to sow any crop. The supply being entirely by percolation, when there is short rainfall the subsoil water-level falls and the wells are apt to run dry just when most wanted.

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1. *Q.* (*The President.*)—I understand you were formerly 2½ years in this province?—Yes.

2. *Q.* You came here specially in connection with famine matters?—No; I came here in June; famine declared itself by August.

3. *Q.* You handed over your place to Mr. Davies?—Yes.

4. *Q.* (*Mr. Ibbetson.*)—Where are you stationed now?—I am Executive Engineer, Poona.

5. *Q.* You say in your memorandum "the chief obstacle to the extension of irrigation is the lack of capital." Is there a strong wish to have irrigation?—I think many of the people would be very glad to have extended irrigation.

6. *Q.* If they can get loans for the purpose from Government?—Yes.

7. *Q.*—Would they take *takavi* loans?—Probably, but there is the great obstacle of the intermingling of States.

8. *Q.* I suppose you mean that any large scheme would require previous agreement with the different Chiefs?—Yes. The surplus water of a canal would perhaps go into a State which would refuse to pay for it. We have had to keep many of our tanks very small, so as to confine the water to one State, though many of the tanks could have been made much larger with advantage.

9. *Q.* How do you arrive at the figures of rainfall given in your statement?—I take the mean between the average and maximum rainfall for ten years.

10. *Q.* You might have stored more water than you did?—Yes, very much more.

11. *Q.* You were limited by financial considerations?—Yes, I tried to get the tanks as near as possible to the places where the famine works were required.

12. *Q.* Are the works that you made capable of enlargement?—I am afraid not more than two of them are capable of enlargement.

13. *Q.* Should not tanks be made so large as to hold a maximum supply of water?—Each case should, I think, be considered on its merits.

14. *Q.* From the point of view of this Commission, the main thing is to see what can be done to meet a future famine?—Famines are very rare here. For about 70 years we had no real famine. These last two or three years have been bad, but probably there will not be anything similar for another hundred years.

15. *Q.* What do you think would be the best means of making Kathiawar strong to resist famine, should it again occur?—The best or at least the cheapest plan would be not to attempt to protect the country, but to put by a certain sum every year for carrying out works when a famine occurs; in fact, Famine Insurance Fund.

16. *Q.* If there were tanks, would the water be fully utilized?—I think it would.

17. *Q.* We have evidence that there is practically no *rabi* cultivation without irrigation?—Practically none.

18. *Q.* I suppose there are a great many possible sites for tanks?—Yes; there are many good sites where tanks could be made, but inter-statal arrangements interfere.

19. *Q.* If one could get over that difficulty, by spending a certain sum of money, a very large area might be added to the valuable cultivation of the province?—Yes.

20. *Q.* It would probably be done without much loss even if it did not pay good interest?—I think it would pay about 4 per cent. or 5 per cent. on the cost; but some of the States are so poor that they would have to borrow the money to build the tanks.

21. *Q.* Supposing all the possible tanks and wells were made, how far would the country be protected?—Perhaps 10 per cent.

22. *Q.* That is by tanks?—Yes.

23. *Q.* You would have to add another 10 per cent. for wells?—Hardly; wells are apt to fail when most required.

24. *Q.* (*Mr. Muir-Mackenzie.*)—Did the wells give out in the first year of famine, 1899-1900?—Yes; and consequently the cultivators did not get full crops; they got about a ten-anna crop.

25. *Q.* (*Mr. Ibbetson.*)—Ten annas on the full area irrigated by the well?—Yes.

26. *Q.* (*The President.*)—Do you know the Bhadar river?—Yes.

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27. *Q.* Are there any suitable sites for making tanks in the hills?—Yes.

28. *Q.* So that, without doing any harm to Porebandar, we may probably find a way for benefiting all the country above Porebandar?—The requirements of the States higher up the river could be met; but you cannot put tanks in one Chief's territory without opposition from the adjoining territory.

29. *Q.* It might be done by strong diplomatic pressure, or if the people themselves are impressed with the importance of irrigation?—Yes.

30. *Q.* Have you been looking after the famine relief works over the whole province of Kathiawar or only in British territory?—I had charge of the Thanas or groups of small States, and also looked after the works in four independent Native States; the other States—Junagad, Bhavnagar, and Jamnagar—made their own arrangements.

31. *Q.* Previous to the famine there was practically no tank irrigation?—Only at Rajkot.

32. *Q.* Irrigation is not one of the old traditions of Kathiawar?—No.

33. *Q.* (*Mr. Muir-Mackenzie.*)—Are there no disused tanks?—In Jasdan State there are two or three old tanks. There is another old *bund* in Junagad.

34. *Q.* What is the meaning of "*doria*"?—A small water channel about 2 or 3 feet wide.

35. *Q.* (*The President.*)—Your dams are, I suppose, earthen?—Yes.

36. *Q.* Was famine labour employed on the earthwork?—Yes.

37. *Q.* How did the cost compare with ordinary Public Works Department rates?—About 30 to 40 per cent. above ordinary rates, exclusive of cost of hutting.

38. *Q.* (*Mr. Muir-Mackenzie.*)—That is a much better result than in British territory?—I do not know.

39. *Q.* (*The President.*)—Are there any works standing in an unfinished condition?—All but four are finished; two of these have again been taken up as famine work this year.

40. *Q.* You say in your memorandum "no legislation is necessary; what is wanted is funds to complete the works already nearly finished, so as to make them remunerative?"—The works have been constructed on the cheapest possible lines. Money is wanted to put them into really good order and complete the canals.

41. *Q.* In making these tanks were you guided at all by any idea of having a chain of tanks down catchment basin?—No. Each tank is an isolated work designed simply to provide famine labour at given centres.

42. *Q.* Near their homes?—As near as possible.

43. *Q.* Have any tanks been actually working?—All of them except the four unfinished ones.

44. *Q.* Are they working now?—Some of them are nearly empty owing to the scanty rainfall of 2½ to 3 inches this year.

45. *Q.* (*Mr. Ibbetson.*)—I understand that you are fairly well acquainted with practically the whole of Kathiawar?—Yes.

46. *Q.* Are you well acquainted with Central Kathiawar?—Yes.

47. *Q.* You say that probably the best way of dealing with famine is to create a sort of insurance fund?—Yes.

48. *Q.* Supposing you are asked, placing that point aside, what are the most effective means of protecting the country against famine; what would you recommend?—Tanks on the hills and weirs across the rivers.

49. *Q.* The construction of weirs, I understand, would be impossible without some co-operation between the States?—I think so.

50. *Q.* This co-operation is possible, then?—Yes.

51. *Q.* By this means you would protect much more than 10 per cent. of the province?—Yes, one-fifth of the province, excluding uncultivable land.

52. *Q.* The other four-fifths you cannot protect?—No; much of the land is very bad.

53. *Q.* Why cannot you improve it?—On account of the natural features of the land; there are no possible means of improving it.

54. *Q.* Are wells possible?—I do not think water would be found. There are no gathering grounds for wells.

55. *Q.* You say a great many of these works would pay 5 per cent. interest to Government?—Yes.

56. *Q.* Do you think it would be cheaper to lay out money like that than to spend it on famine relief which brings in no return?—Yes, I think so, because when you have famine works you have to incur extra expenses for hospitals, etc.

57. *Q.* Would it not be still cheaper to make your tanks not by famine labour but by ordinary labour and get your 5 per cent. and save a corresponding amount by the protection afforded?—I think so.

58. *Q.* You think at any rate it would not cost the State much more?—No.

59. *Q.* It would be worth while having these works as a protection against famine?—Yes. They increase the value and the outturn of crops all round.

60. *Q.* All the works in the statement are nearly finished and are estimated to pay a reasonable percentage and some exceedingly high percentages? That looks as if they are in full working order. Do you think that the average of 5 per cent. would be exceeded?—I think not all round.

61. *Q.* When you estimate 5 per cent., what figures do you include?—Simply water revenue.

62. *Q.* You do not include anything for enhancement of the ordinary land revenue?—No; on the other hand, we do not take into account loss by lands swamped or taken up by canals.

63. *Q.* Surely an increased yield from the area irrigated would be much more than compensation for that?—Yes.

64. *Q.* Would you say 6½ per cent. inclusive of all sources of additional income?—Yes, that is a safe estimate.

65. *Q.* Do you include benefit to wells by raising the spring level?—No.

66. *Q.* Taking that into account you get a considerable enhancement?—Yes.

67. *Q.* The profits you show are *net*, after deducting the cost of maintenance?—Yes, they seem high, the reason being that the fields are close to the tanks. In the Deccan the water has to be carried a long way to the fields.

68. *Q.* You say "previous to the famine there were practically no tanks." That means that there had been no survey. Would it not be a good thing to make a special survey to enable the Engineer to say where a tank is possible and would be successful and where it is impossible?—I think that would be a very good plan; but first of all it would be necessary to make some political arrangement with the States. I do not think anything can be done without that.

69. *Q.* Suppose this can be arranged?—Then it would be worth while making a survey.

70. *Q.* I suppose the States have lost enormously during the famine, taking the expenses of relief work and loss of revenue?—Yes.

71. *Q.* Do you think that loss would induce the States to agree to any measure which might protect them in future?—It is, I think, doubtful.

72. *Q.* At any rate you think they would take loans and start works if the money were lent to them at reasonable interest?—I think they would.

73. *Q.* Do you think they are keen about irrigation at present?—I do not think they are.

74. *Q.* You say that about 10 per cent. of the cultivable land can be protected by wells so far as protection is possible?—Yes.

75. *Q.* Can you not extend the wells and protect a much larger area?—I think not.

76. *Q.* What is the obstacle?—There is a large area of dry crop lands in the hills and uplands which cannot be protected.

77. *Q.* You say that this year you had a very short rainfall and most of your tanks were empty?—Yes.

78. *Q.* And still you have a substantial amount of irrigation?—At Jasdan they had 3,000 acres this year.

79. *Q.* In years of scanty rainfall, I suppose, the tanks will not fill?—You must have ten or twelve inches of rain to fill the tanks.

80. *Q.* (*Mr. Muir-Mackenzie.*)—What is your average rainfall?—About 25 to 27 inches.

81. *Q.* Do I understand you to say that 10 to 12 inches of rainfall would suffice to fill every tank?—Yes.

82. *Q.* (*Mr. Ibbetson.*)—With that rainfall you would have full tanks?—Yes; last year we had about 11 inches in one day and the tanks were filled up at once.

83. *Q.* They were filled by a continuous rainfall of 10 to 12 inches?—Yes.

84. *Q.* In your judgment, if you get less 10 or 12 inches of rainfall, there would be a very considerable chance of failure of crops?—I think so.

85. *Q.* You charge a water-rate of 5 to 11 rupees per acre on the Lalpuri tank; do they use all the water?—Yes.

86. *Q.* They have got a sufficient area under cultivation? —Yes; and the situation is favourable, as there is a good market within 2 miles.

87. *Q.* You refer to "small irrigation channels deriving their supply from streams." Are these common?—No.

88. *Q.* You think their number could be increased?—I think it could, very largely.

89. *Q.* (*The President.*)—In what proportion?—I cannot say.

90. *Q.* Do you think that much could be done in that way?—Yes.

91. *Q.* Do you think the people would construct the works themselves?—I think they would.

92. *Q.* (*Mr. Ibbetson.*)—You say that "the average rate for water amounts to about Rs. 4-8 to Rs. 6-8 per acre according to the situation and soil." Is there any remission in a famine year?—Yes; we make allowances.

93. *Q.* Supposing it were found possible to increase the supply of water largely, do you think it would be wise to reduce these rates so as to encourage the use of water?—As a matter of commercial enterprise, it would not; but from a protective point of view it would.

94. *Q.* Why not as a commercial matter?—There would be extra establishment charges as you increase the area; the dams cost little to maintain; but as the irrigated area increases, the establishment charges also increase.

95. *Q.* Putting the commercial aspect aside, do you think that by reducing the rates you would encourage the use of water?—Yes; the people would take the water for *juari* and *bajri*.

96. *Q.* They would water *bajri* and *juari* during the rains?—Yes, if the rainfall was short.

97. *Q.* That is when you have got water to spare?—Yes.

98. *Q.* It would not affect your supply for *rabi*?—Practically not.

99. *Q.* Are wells easily exhausted?—Yes, in years of scanty rainfall.

100. *Q.* (*Mr. Muir-Mackenzie.*)—They won't work the irrigation wells in ordinary years?—Only to a small extent.

101. *Q.* (*Mr. Ibbetson.*)—They could get more from their wells and irrigate a larger area in ordinary years?—Yes.

102. *Q.* Does not the level of the water in wells go down very much in famine years?—Yes, in some wells it went down 10 or 12 feet.

103. *Q.* Do you contemplate the construction of tanks holding a two years' supply?—No. We would lose too much by evaporation.

104. *Q.* You do not advocate them?—No.

105. *Q.* You could make such tanks in some places?—Yes.

106. *Q.* Having got your large tanks holding sufficient storage for two years, would you refuse to give water in one year in order to hold it for next year?—If you mean on the chance of short rainfall next year, I think I would rather take the chance and use up all the water.

107. *Q.* A few big tanks are of very much greater value as irrigation works than a number of small tanks holding the same amount of water?—Yes.

108. *Q.* I see it stated "15,000 wells made by the State in Junagad for Rs. 200 each pay 50 per cent." If wells can be made to pay profits like that, why is not the number very largely increased?—I doubt the figures.

109. *Q.* There is a good deal of uncertainty about sinking wells in Kathiawar?—Yes.

110. *Q.* Can you, as an Engineer, say with any certainty what would be the result of boring for wells?—Not with absolute certainty, but you can form a reliable estimate.

111. *Q.* Do you think that boring would not be worth doing?—I do not think it would.

112. *Q.* Why not?—We tried boring, but for want of skilled labour we did not succeed.

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113. *Q.* (*Mr. Muir-Mackenzie.*)—We have had all sorts of evidence as to what a well costs. Some are said to cost very little?—Those are *kachcha* wells; they last a year or two and then tumble in.

114. *Q.* (*Mr. Ibbetson.*)—They may last 40 years if you protect them?—Yes, if protected and steined; an ordinary well would cost Rs. 400; a large and deep well Rs. 2,000.

115. *Q.* (*The President.*)—Mr. Gopal Das, in his memorandum, says that a well 42 to 52 feet deep costs Rs. 200 to Rs. 400?—I doubt the figures; I do not think you can build a well 52 feet deep for Rs. 400. You would have to pay Rs. 1,500 for such a well. I have built several wells and speak from practical experience.

116. *Q.* What would be the diameter of such a well?—Thirty feet.

117. *Q.* (*Mr. Muir-Mackenzie.*)—Is it your experience of some tanks in British territory that people would sooner wait to the very last moment for rain rather than take the trouble of making distributing channels and pay even the light rate which falls on them?—Yes. They should be made to pay a very light rate on all the lands commanded, so that they pay whether they take water or not.

118. *Q.* If, on the other hand, you put a water-rate on the tank and first start by demanding a very low rate, do you think that would be a good policy?—I think there might be difficulty in raising the rates afterwards. I think that in British territory they raise the rates every five years; it would be very difficult to do so here.

119. *Q.* Why? A man is charged low rates and finds he gets valuable crops, and profit of, say, Rs. 20 an acre. If you put on a rupee more to the rate, it would be still worth his while to take the profit of Rs. 19?—My experience is that he will say: "for five years I paid so much; why should I now pay more?"

120. *Q.* Would there be no chance of digging small tanks in Bhavnagar where there is black soil?—In Bhavnagar you could. They have also got a few village tanks up in the north-east of Kathiawar.

121. *Q.* Do you consider that the digging of tanks or bunding up would be likely to result in improvement by washing the soil?—I think it would. I proposed this for Runn.

122. *Q.* Do you know anything about water-logged areas? —Nothing.

123. *Q.* You have no experience of draining?—No.

124. *Q.* A great number of wells were dug in the famine?—Yes.

125. *Q.* Is there any chance of these wells being maintained?—Only in the western parts where water is very near the surface.

126. *Q.* They would be unused in ordinary years?—Yes; they will let them go out of repair even though they have money to repair them.

127. *Q.* Would it be advisable for the State to advance them money to do that?—Yes.

128. *Q.* Does the State take Rs. 5-8 an acre on wells?—I think they only take an increased share of the produce; one-fourth instead of one-sixth; that is about the average share.

129. *Q.* Does the share of produce vary much in different States?—Not very much.

130. *Q.* Have you ever heard of a system by which the State takes so much per *kos* instead of a fixed assessment? —No.

131. *Q.* I understand this is done in Bhavnagar?—I do not know that. I have never heard of it.

132. *Q.* (*Mr. Rajaratna Mudaliar.*)—You say famine is almost unknown in this district?—Yes.

133. *Q.* There is practically no irrigation of recent date? —None, until three years ago.

134. *Q.* The rayat is able to obtain a fairly good outturn from dry crops in normal years?—Yes.

135. *Q.* Do they consider that it is better to raise dry crops than wet crops which certainly takes a larger expenditure?—I think it is only very recently that they have learnt the benefits of irrigation. Here, near Rajkot, they have good irrigation; every field under command is irrigated and there is great competition to get water.

136. *Q.* (*Mr. Ibbetson.*)—You are talking of irrigation from tanks entirely?—Yes.

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137. *Q.* You say "the area irrigated by wells depends on the size of the wells;" are there different sizes? What is the diameter of an ordinary well?—From 20 feet up to 50 feet.

138. *Q.* (*Mr. Rajaratna Mudaliar.*)—They irrigate only about five or six acres?—No; about eight acres as a rule.

139. *Q.* In a well 50 feet in diameter you can have about a dozen *mots* or so?—You ought to have; the people generally use four *mots* in a large well.

140. *Q.* How deep is a well sunk?—About 30 to 35 feet on an average. You can sink a little *kachcha* well of 30 feet for Rs. 600.

Proceedings of the Government of Mysore, Revenue, dated 24th January 1902.

Read again—

Government Proceedings No. 4115-7-R.-1414, dated 5th November 1896, directing a re-classification of rice and garden lands in Davangere and six other taluks of the Chitaldrug district with special reference to the value assignable to the water-supply now enjoyed by the lands.

Read—

Memorandum by the Superintendent, Revenue Survey, received in August 1901 on the subject of treatment at revision of assessment of gardens irrigated by means of wells.

No. R.-3138-46-R. F.-8-1900, dated Bangalore, 24th January 1902.

ORDER THEREON.—After mature consideration, the Government of Mysore are pleased to direct that the revision of assessment on well-irrigated lands be carried out at the re-survey according to the following principles:—

(I) Well-irrigated land brought under irrigation since the last settlement to be assessed at simple dry crop rates, if the wells belong to class I; and within the highest dry rates, if the wells fall under classes II and III.

(II) Well-irrigated land recorded as such at the last settlement should be assessed at dry rates, if the well supply has failed.

(III) Well-gardens, recorded as such at the last settlement, shall be assessed within the highest dry crop rate, if they solely depend on wells which received no aid directly or indirectly from Government works and fall under class I.

(IV) Well-gardens, recorded as such at the last settlement if they are irrigated from wells falling under class II or III, will be assessed on their merits.

(V) Well-gardens enjoying both well and tank supply (class IV) should be assessed on the superior supply, *i.e.*, the tank.

(VI) The existing rates on lands referred to in rules II, III and IV above are not to be raised at the revision.

The following is a rough description of the classes of wells referred to above:—

I. Wells purely self-dependent situated neither below nor above any Government tank, nor below any Government channel, subdivided as follows:—

- (*a*) *Pakka* wells, crops grown various.
- (*b*) Cheap, often merely temporary wells used for what is known as "Khushki Bagait," almost always cocoanut cultivation, water only necessary whilst trees are young.

II. Wells sunk all along the banks of streams and for the most part outside the boundaries of the occupancies they irrigate. These wells are not very costly.

III. Wells sunk within a tank series, either above or below a Government tank or below Government channel. These wells are directly or indirectly dependent on Government works; when they are in the "Atchkat" of a tank, the holders prefer the percolation to supply by gravitation from the tank or other work. They like having complete control over the water they use. In all these wells, the existence and maintenance of Government tanks is of vital importance as keeping up the level of the water in the wells.

IV. Wells under a tank or other work and only supplementary to the tank or channel supply.

Colonel J. P. Grant.

COLONEL J. P. GRANT, Superintendent, Mysore Revenue Survey.

(*Bangalore, 18th January 1902.*)

Confining my remarks and replies strictly to points with which I am conversant from personal observation, or regarding which the operations of my department have naturally put me in possession of some information, I submit the following:—

Query 1.—I know the whole province pretty intimately, having personally settled seven-eighths of the taluks, and have also been present at the earlier settlements in 1863, although at that time only in charge of measuring and classing operations, which however enabled me to see the country very minutely.

3. (2) and (3) of this question are embraced by (1). If population be sparse, it would be unreasonable to expect (excepting in purely grazing tracts) many cattle, and consequently much manure; for, excepting leaf manure from the Honge tree (*pongamia glabra*) used, wherever available, chiefly in the eastern district of Kolar, no other manure is made use of. The most sparsely-populated portions of the province are the taluks of Challakere in the Chitaldrug district and the taluk of Pavagada in the Tumkur district. The taluk of Hiriyur in the Chitaldrug district is also very poorly populated. Viewed as a district, Chitaldrug is the most sparsely populated tract in the province; but the population is unequally distributed, decreasing from west to east. The holdings in the eastern parts run very large and the dry crop lands are but seldom manured. The large stretches of black cotton soil are annually cultivated, but the red and sandy stretches, being never manured, are put under crop only once in two or even three years. The western part of the district contains much smaller holdings, enjoys a better rainfall, and manure is used more or less. The above remarks apply to dry crop lands. Garden and wet lands, wherever situated, are manured. The question asked is, whether such a state of things as I have described constitutes an obstacle to the extension of irrigation. Irrigation is more prized in the eastern and bad parts than in the western and better parts, because in the former the people have nothing else to depend upon, their dry crop cultivation being quite insufficient for their existence, while in the western and better part dry crops are remunerative. I may safely say that the sparsity of population is no obstacle to the extension of irrigation, for the people, never manuring the dry lands, have enough manure for the irrigated lands, which are not available to the extent the people are quite prepared to undertake. There are, fortunately, many natural springs called *talpargis* in the eastern taluks, which are made use of by long channels led from their source, and every stream and likely low-lying spot is eagerly competed for. The eastern rayats are far more skilful cultivators of wet land than the western rayats who, having dry crops to fall back on, are callous about irrigation and unskilful in regard to the little they have.

(4) The suitability or otherwise of the soil to irrigation is a question of enormous importance. The question turns entirely upon black cotton soil, for we know that other soils may be pronounced suitable, but regarding the suitability of black soil opinions are divided. There are considerable stretches of black soil in the Davangere, Chitaldrug, and Hiriyur taluks. If black soil is unsuitable to irrigation, important works of irrigation contemplated or in hand will be defeated in their main object and will certainly not be remunerative; the Marikanave project, for instance. I will briefly give my opinion for what it is worth. We know that the rayats who occupy black soil, rightly or wrongly, have some prejudice against using irrigation. They have hardly even made the experiment, the real truth being that the dry cultivation of black soil is very easy and a bumper year makes up for several years of bad yield. Moreover, the rayats of these black cotton soil parts are quite unaccustomed to irrigation. Could the Pavagada and more eastern rayats be imported to Hiriyur, I have no doubt they could make something of the opportunities offered. My own opinion is that black-cotton soil does

not admit of regular irrigation, and that the means of irrigation provided, water would go little farther than saving the crops by moderate waterings. I speak here of irrigation for ordinary dry crops. If black cotton soil be converted into what is known as wet land, I believe that it will take several years before good crops are obtained, and then only because sand and other earth has gradually been intermixed and the whole has become friable.

(5) Uncertainty of supply of water is a factor in depreciation everywhere. In all, excepting the most western parts of the province where tanks are of little count and rarely constructed, there is always more or less uncertainty as to whether a tank will fill. Speaking in general terms, this uncertainty is the greatest where the rainfall is least. A bad rainfall is of course an obstacle to extension of irrigation; but, on the other hand, a country possessing a bad rainfall is just where irrigation is most necessary and most appreciated. The tanks in the eastern parts of the province trust to the north-east monsoon for their filling; those in the central and western parts to the south-west monsoon; consequently, in the former case, the rayats wait for what are called "Vaisak" or late crops; in the latter, the rayats take, indeed generally are forced to take, "Kartik" or early wet crop. Such conditions no doubt involve uncertainty and risk, but it could not with accuracy be said that they are an obstacle to the extension of irrigation.

(6) Lack of capital there no doubt is; but, as I have already observed, there will be no want of rayats coming forward, especially in the eastern parts of the province, if the land and the means of irrigation are offered them. These eastern rayats are the men who should be encouraged by grant of loans and assistance generally. They are the most industrious of all our rayats and would repay what was lent them.

(7) I do not believe that the fear of enhanced revenue assessment enters into the calculations of rayats in taking up land, irrigable or otherwise.

(8) I believe the tenure in Mysore to be as sound and secure as any in India.

(9) I know of no reason why irrigation should not extend when soil and water are available. There is of course the black cotton soil uncertainty, and there is also the extreme reluctance on the part of rayats, unaccustomed to irrigation, to commence a new mode of cultivation. These points, especially the first, cannot be disregarded.

4. What are known as "swant kere" or private tanks, when repaired or constructed, and maintained by private individuals, pay only three-fourths of the full wet assessment. This concession is permanent; only the full assessment is liable to revision when a fresh settlement is made. An occupant, under the survey settlement, can construct a tank in his own land to irrigate lands in his holding, and there will be no enhancement of the revenue assessment. I consider the above concessions sufficiently liberal.

6. The extension of irrigation does not injure other cultivation; on the contrary, it favours it, inasmuch as more capital is produced. Dry cultivation may stand in the way of irrigation of other lands, but never can irrigation stand in the way of dry cultivation.

7. I am not clear as to what is meant by a canal of continuous flow. In the case of river channels led from rivers like the Cauvery in Mysore, the water is usually shut off in January and is afterwards let on for ten days at a time for the irrigation of sugarcane. If by continuous flow is meant that the water is let on at all times and two harvests rendered possible, the value of the produce of land would be enormously increased. A not unfair estimate is given below, not based on any average, but still applicable to land which has come under my notice:—

Description.	Produce value, Rs.		
	Year of ample rain.	Year of normal rain.	Year of drought.
Dry cultivation . . .	20	16	2
River channel, two harvests .	90	90	90
River channel, single harvest.	60	60	60

In my experience the supply from a good river in Mysore varies little. The *value* of the produce would probably be greater in a bad year, but this I have not allowed for. It is impossible to say too much of the value of river channel irrigation.

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9. (1) In Mysore there are no private owners of river channels or canals.

(2) The commonest practice is for the owner to sublet on "waram" or half the gross produce, and sometimes on "gutta" or fixed rate coming to about the same figure. In either case the owner pays the revenue assessment. This rate must necessarily be on the area actually cultivated.

(3) Under a channel drawn, say from the Cauvery, Rs. 8 per acre would be a high rate; Rs. 4 per acre would be a comparatively low rate. The difference would be due to difference in facility of water-supply, difference in class of soil, and deteriorating qualities in the soil, as, for instance, salt efflorescence. Both water and soil class are combined to work out the rate of assessment. The rate is paid on the whole irrigable area in occupancy.

10. So far as I am aware, the maintenance of the minor distribution channels devolves on the occupant or tenant; that of the main channel on Government. I never have heard of recoupment being given or asked for.

11. Salt efflorescence, "upalwat," or water-logging, the presence of any deteriorating quality or defect in the soil, are, when met with, duly allowed for at time of classification and the rate reduced accordingly. Water-logging is not very common; the remedy is drainage. Drainage is resorted to in plantain gardens and in betel-nut gardens.

12 to 21. The canals here alluded to I take to mean channels led from interior streams compared with class B. There are a few such channels in Mysore, but the dams are not necessarily temporary. I need not repeat my remarks on queries Nos. 7 to 11 which apply, in a modified degree, to these less pretentious channels.

22. I do not consider it advisable to encourage and assist the construction by private persons of works taking such high rank as river channels.

D.—Tanks.

23. (1) The tank system has been developed to an extraordinary extent all over the province; in the Kolar district perhaps more than anywhere else; but Mysore, as a whole, possesses more tanks than any other equal area in India. The Engineer, the Revenue Officer, and the rayats have from time immemorial been in search of suitable sites for tanks. It was one of the chief and most interesting duties of the Revenue Officer, and the rayats were invariably pointing out what could be done. Under such circumstances, in a country peculiarly adapted to the purpose and containing many facilities, an immense number of tanks have been constructed. They are the life of the country, and three-fourths of the wells in the province are directly or indirectly dependent on them.

(2) Almost every village which possesses a tank has its "nirganti" or hereditary village servant, whose duty it is to regulate the distribution of water.

(3) The period for which the water supplied lasts varies in every possible degree from the first class tank to the humble "katte" or pond irrigating only two or three acres. Very few tanks are really first class. Two harvests are quite the exception; still they are taken in a few instances. By far the majority of tanks suffice for only one harvest: certain under the better tanks, precarious under the ordinary tanks, according to the season. Some tanks fill every year, the channels running up to March and April; others fill only once in three or four years; and why this difference should exist even an Engineer would find it difficult to explain. The area irrigated in some cases is ludicrously out of proportion to the supply stored. The assessment is fixed on the *average* supply of water during a number of years, and the ascertainment of this point is one of the most difficult duties of the Classing Officer.

(4) A correct answer to this question is beyond human power. Thousand causes lead to more or less area being irrigated: the area available, the inclination, means, and skill of the rayats, the condition of the tank, and so forth.

24. We may assume that tank irrigation increases the value of the produce of land in every case but in countless degrees.

(1) Double harvests are rare.

(2) Gardens of perennial and valuable produce are more common under tanks than under river channels, and the class of the tank is no index to the superior garden cultivation in question. The reason why gardens under river channels are uncommon is that the percolation in the case of tanks is so much greater. Tanks are always constructed

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in low-lying situations; river channels run anywhere. Even the smallest tanks have sometimes superior gardens under them. Gardens unaided by wells are very rare.

(3) Already replied to under query 23.

25. Already replied to.

26. This is a very important question and will be replied to under E.—Wells.

27. I cannot. Circumstances vary too much.

28. (2) The owner usually sublets on "waram" or half produce, owner paying the revenue assessment.

(3) Assessment varies in every possible degree from almost purely dry crop rate to Rs. 6 or even Rs. 7. I speak of ordinary wet land growing rice and sugarcane. Betel-nut and other superior produce the State has from time immemorial asserted its right to share in, and garden rates run higher than ordinary wet rates.

In (2) the rate is of course on the area actually cultivated; in (3) it is on the whole irrigable area occupied.

29. Already answered under clauses B and C.

30. The tank is the care of Government; also the main channels in the case of very large tanks. The distribution channels rest with the owner or tenant. I have never heard of recoupment being asked for or granted.

31. Government assists owners of private tanks with professional advice and work, when necessary. The owner maintains the tanks. The minor distribution of water is very much the same as in the case of Government tanks.

32. Yes, in the case of repair and restoration of dilapidated tanks, but always under preliminary professional inquiry. The construction of new tanks I do not regard as a safe concession, nor yet the restoration of abandoned tanks, for they have probably been abandoned by Government intentionally. Carelessly granted permission might endanger the whole series of tanks.

E.—Wells.

34. (1) I cannot better answer this than by submitting for the inspection of the Commission (and kind return) a well map, which I had prepared for my own use, of the Chitaldrug district.

The lift of water from surface to roller or fulcrum varies greatly. In the Bangalore and Kolar districts, where water is near the surface, the *pakota* is used. These wells are exceedingly valuable and nearly all are dependent, directly or indirectly, on tanks. Water is often within 3 and 4 feet of the surface of the ground. Wells of this kind represent, in my opinion, the most valuable kind of cultivation in the province.

(5) Depends entirely on depth of water. "Pakotas" where water is near surface; "kapile" wells where water is far below the surface.

(6) & (7) Areas vary so much that data for striking an average are wanting. The area commanded by a well is often limited by the area in the owner's possession. A deep well often irrigates from 3 to 4 acres. In Bangalore and Kolar districts the *pakota* wells are often shifted from one spot to another at pleasure, or as many new wells sunk as may be required.

35. In my opinion well irrigation produces the best crops in the province. Irrigation from wells increases the value of the produce of land enormously, especially in districts like Bangalore and Kolar.

(1) & (2) Under wells the variety of crops raised is greater than under any other kind of irrigation. Superior garden crops, such as betel-nut, cocoanut, panvel (creeper), mulberry, are, almost invariably, irrigated from wells. A garden, cocoanut excepted, is rarely found without a well. The best vegetables are always under wells. The wells are in many cases supplemental to tank supply, but many gardens are raised under wells alone. In gardens under tanks the tank water is rarely used by gravitation; all the garden owners care for is the position; the watering is done from the well.

(3) No accurate estimate can be made; the yield *must* be greatly increased.

36. Any attempt to make such an estimate would be futile. I was informed on good authority that the gross yield per acre under some of the "pakota" wells exceeded Rs. 200 in value. The variety of crops raised is so great as to defeat any attempt at estimate which, to be of use, should be with reference to one particular crop.

(2) The supply is from springs in the case of deep wells, and from percolation and the high level maintained by the presence of tanks in the wells in the Bangalore and Kolar taluks just described. I do not think there are many instances of the water becoming too saline. As a proof of the advantage of tanks to wells, I may mention that when a tank is for any reason abandoned, a storm of protest arises from owners of wells both above and below.

(3) The cost of wells varies greatly from that of the cheap and often-shifted wells where water is near the surface to that of the deep wells sunk in less favoured spots. The wells sunk in the beds or on the edges of streams (a class not inquired about by the Commission) are very cheap. Unfortunately, the cost of wells is in inverse ratio to the value of the water when raised; in other words, the Kolar and Bangalore districts have the cheapest wells and the best cultivation; the Chitaldrug district has the most costly wells and inferior cultivation. Near tanks, wells are cheap; independent of tanks, they are costly. A well in the former case might cost Rs. 30 or Rs. 40; in the second case, as much as Rs. 800 or Rs. 400. The "pakota" used indicates water near the surface; the "kapile" well, where the leather bucket is worked by bullocks on an inclined plane, indicates considerable depth. The "pakota" is common in the Kolar and Bangalore districts; the "kapile" wells are common in the Chitaldrug district—the inference is obvious.

(4) Wells near tanks last long; those independent of tanks and fed from springs are uncertain; new wells found near them often diminish the supply in the old ones. On the whole, the duration of wells in Mysore is good.

37. I do not think subletting is at all common in the case of well-irrigated lands.

(2) The assessment paid to Government by the owner of a well varies from Re. 1 to even Rs. 8 or Rs. 10 per acre. In the case of "kapile" wells, the rate is usually low. The rate is no proper indication of the weight of the assessment which is really on the well. A well irrigating only one acre when it was capable of irrigating 3 or 4 acres would have a comparatively high rate on that one acre. Conversely, a well irrigating to its full capacity, the rate would be comparatively low. The depth of the water from the surface, the cost of the well, and its duration (in hours working per day), are all factors in fixing the assessment. No lands are more prized than well-irrigated lands, and on no lands is the assessment so easily and readily paid.

The rate paid to Government is on the area recorded at the original settlement as under irrigation; and if the owner extends the area under irrigation, no enhancement of revenue occurs, nor will any enhancement occur at a revised settlement.

38. In the case of "kapile" wells, difficulty no doubt occurs in selecting a spot, and the man who sinks the well often does not know when water will be met, and no doubt he runs a good deal of risk. In the high class "pakota" wells such difficulties and risks are few. Government has been extremely liberal in advancing money for the sinking of wells, but not, I believe, with very important results. As regards expert advice, I am inclined to believe that the rayat has not much to learn in the selection of spot and sinking; but, in the matter of raising the water, expert advice would be of great use. Cost is the usual drawback in inducing the rayats to adopt any improved mode of raising water. What must be shown them, by exhibition at some central place, is a *cheap* method. Expensive methods they will have nothing to do with. An exhibition was once held at Mysore with the above objects, and many good methods were practically illustrated, but they were all too costly.

39. I do not believe in the practicability of the suggestion here made.

40. I have already stated that in the Bangalore and Kolar districts, and in short anywhere where water is near the surface, wells are not only cheap but are often temporary, their site being shifted frequently and new wells sunk as required. They are not only extremely valuable for the crops raised, but they eke out the means of subsistence wonderfully in bad years. A year of scarcity, if severe, is not a time when people care to engage in constructing wells, even when helped by Government. Every encouragement, however, should be given, and no more fitting object for the rules framed under section 194 of the Land Revenue Code (Government Proceedings No. 2548-56, dated 10th December 1901).

General.—The Commission have left out of their questionings some classes of irrigation which deserve a word of notice.

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Malnad rice lands.—In the western (Malnad) tracts there are large areas of rice land dependent upon perennial hill streams unaided by tanks. The water-supply is very certain and a considerable proportion of the land is double crop and will continue to be so unless any unwise policy denuded the forests, when they would certainly revert into single-crop lands.

These rice-producing tracts (I say nothing of the betel-nut gardens of which the Malnad is the home) are of immense importance to the country generally.

Wells in beds and edges of streams.—A far larger proportion of well irrigation than is generally supposed is conducted on the banks of streams, or rather in the holdings which adjoin them, by means of wells sunk in the beds or just on the margin of such streams. This is a very common feature in Mysore well cultivation, and fortunately such cultivation is found to a considerable extent in the eastern and north-eastern parts of the Chitaldrug district, of which I have given so unfavourable an account.

"*Saguvali kattes*" *in black soil.*—In the black cotton soil tracts in the Hiriyur, Chitaldrug, and Davangere taluks of the Chitaldrug district there is a practice, very common, of running up embankments in favourable spots, not to hold water, but to collect silt and soil. In these "saguvali kattes," as they are called, even in bad seasons, jola, chenna, and sometimes wheat and cotton, are raised, where elsewhere the crops are a failure. These works should be encouraged; at any rate they should never be prohibited. They do not concern the irrigation question, but are worthy of mention as an undoubted factor is in the guard against bad seasons. As bearing upon the question of irrigation so far as it can be affected by the revenue demand, I may mention that the Government of Mysore has most wisely, indeed necessarily, sanctioned an entire re-classification of the *water* supply to all irrigable lands. This re-classification is completed in about six taluks and will be incorporated in the revision settlement. The measure ensures two desiderata—

1st.—The wet assessment will be based on the data of the present time, not on the data of 30 years ago, since when many changes in water-supply have occurred.

2nd.—A liberal policy in the revision of the assessment of well-irrigated land will be possible, calculated to afford every encouragement to the present holders of wells and to others who may wish to sink new wells. It is premature to sketch the outlines of this policy, but I have no doubt it will be on liberal lines.

If I may be permitted to offer an opinion, I would say that the true policy for the Mysore Government to adopt, in view of the contingency of bad seasons, is a thorough repair of tanks, large and small, or major and minor, as they are defined. I have shown that three-fourths of the wells are dependent, one way or another, on tanks; and in doing the best possible for the latter the former will equally improve. River channels have every care and contribute enormously to the general prosperity, but the tanks, not forgetting the small ones, and the wells so intimately allied with them, are the very life of the people, and what relief they give in bad times is at the people's doors.

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1. *Q.* (*The President.*)—You have been for many years connected with Mysore?—Yes, since 1863.

2. *Q.* No doubt you have seen many changes in the province since then?—Yes, great changes.

3. *Q.* Looking back to the dark days of famine, is the country in a better position than then do you think?—Yes, owing to the extension of railways, improved irrigation and general advance.

4. *Q.* You say in paragraph 4 "the suitability or otherwise of the soil to irrigation is a question of enormous importance. The question turns entirely upon black cotton soil." That is exactly our experience wherever we have been; this question is most important; do you differentiate between black cotton soils?—I think it would depend chiefly on the locality and the inclination of the people. I know of many cases in which black cotton soil is irrigated fairly successfully. I am told that when crops are grown on it, the grain becomes coarser and the straw improves; the fact is that people are unwilling to attempt irrigation on black soil, not so much because they think it cannot be irrigated, but because they are disinclined to attempt a new mode of irrigation. I think it depends on the locality in which the black soil is situated and the agricultural skill and inclination of the people. If there were black soil in the east of Mysore, there is no doubt that it would be taken up; if you offered it in the centre of Mysore, where the population is not so great and dry cultivation is sufficient, people would not willingly come forward and take it up.

5. *Q.* They would be content with their dry cultivation?—Yes, if the population is not very large; if the population is large, they would undoubtedly take it up.

6. *Q.* Would they grow and irrigate dry crops upon it?—I think the utmost they would do in the parts where black soil is found would be to attempt to save their crops; I doubt if they would undertake wet cultivation, that is, rice and sugarcane.

7. *Q.* (*Mr. Ibbetson.*)—Are you speaking of the Mysore district?—The central parts of Mysore.

8. *Q.* (*The President.*)—In the other parts?—I think they would take it up in well-populated parts.

9. *Q.* Would it be mainly rice?—Rice and sugarcane. In the extreme east of Mysore people are very skilful wet cultivators; I believe they would take up any irrigation that offered; in the central parts, where the population is not great, dry cultivation suffices. In Tumkur they will not come forward and undertake irrigation; that is my experience.

10. *Q.* We have found the answer given in many places that if black soil is not very deep, and if there is *muram* below it, they would irrigate; but if there is a deep stratum of black soil, they would not?—I think almost all soil changes its character under irrigation; a mixture even a little below the surface would be an advantage; there is not the slightest doubt that if black soil were taken up for irrigation, it would change its character after four or five years; silt and other soil would be introduced; it would improve though it would take time; that is what I am told.

11. *Q.* We have been given to understand that irrigation of black soil would only be resorted to under pressure in a year of drought for dry crops; and it is only then that the rayat would take water; what do you think?—I think so. There has never been anything done in Mysore to show what the people would do; they have been unwilling to undertake an experiment, and we have no means of knowing what they would do.

12. *Q.* As far as I remember of Mysore, they prefer growing their own food, such as *ragi* and *cholam* to rice?—Yes, *ragi* and *jowar* in certain parts.

13. *Q.* In the famine days people preferred *ragi* to rice in the famine relief camps?—Yes.

14. *Q.* You allude to the many natural springs; where are these springs found?—If you take a line from Kortagiri, east of Tumkur, and proceed northwards towards Mulkalmuru taluk, it is along that line that the channels are found; there are a great many rocky hills very conducive to the existence of these channels, and they are of great advantage to the country.

15. *Q.* The springs discharge enough water to make it worth while to make the channels?—Yes; they carry their channels a long way.

16. *Q.* Have they natural channels?—They have to make the channels.

17. *Q.* (*Mr. Nicholson.*)—Would they irrigate up to 50 acres?—I should say they would in some cases.

18. *Q.* Where the supply is good?—Yes; that would be a large area.

19. *Q.* Usually it is only a few acres?—Yes; still sometimes up to 50 acres.

20. *Q.* (*The President.*)—You say in paragraph 6 "these eastern rayats are the men who should be encouraged by grant of loans and assistance generally. They are the most industrious of all our rayats, and would repay what was lent them." With what object are these loans given?—For wells chiefly. I am alluding more particularly to the rules which have very recently been framed under section 194 of the Land Revenue Act.

21. *Q.* That applies to Mysore?—Yes.

22. *Q.* Are they readily availed of?—I don't think the rules have been working sufficiently long for us to know; during the famine efforts were made to get the people to sink wells; that is not a time at which they are prepared to do anything; it is a mistake, in my opinion, to try to push the people to borrow money; let them come forward of their own accord.

23. *Q.* (*Mr. Ibbetson.*)—Are these rules for Government advances?—Yes.

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24. *Q.* Had they not been made before?—They were very recently made.

25. *Q.* Had no advances been made previously?—Yes; during the famine Mysore has always been very liberal in the matter of advances.

26. *Q.* (*Mr. Muir-Mackenzie.*)—Were they made only in the famine?—No; there are rules existing for the grant of loans for many objects; they have not been embodied in any rules under the Code.

27. *Q.* In executive orders?—Yes.

28. *Q.* (*Mr. Nicholson.*)—The agricultural banks scheme is one method of advancing *takavi* to groups of rayats?—I believe so.

29. *Q.* A great deal has been given by that means; has there not?—I am not in a position to give a positive answer on that point.

30. *Q.* (*The President.*)—Is there much dissatisfaction with the state of the tanks not being kept up to the mark?—Yes; there is a great deal of trouble in that respect; I allude chiefly to the minor tanks; there are 40,000 tanks in this province; minor tanks are of very great importance to the people; there is always difficulty in getting them to take their share in keeping them in order; so far as I know, the rayats will never let a tank breach; should there be danger of a breach, they at once repair it; but instead of good work being done, there is always makeshift work, which is, I imagine, unsafe; they are most reluctant to have anything to do with the ordinary maintenance, though they are aware of the advantage of these tanks.

31. *Q.* Is there a feeling that Government should do it?—They are always desirous that Government should do it and ask that Government should do it.

32. *Q.* In Bombay there is a feeling among the people that, if they pay wet assessment, then Government should keep the tank in order?—I do not think they quite understand that question; I am talking of the ordinary rayat.

33. *Q.* You say in paragraph 11 "salt efflorescence, 'npalwat,' or water-logging, the presence of any deteriorating quality or defect in the soil, are, when met with, duly allowed for at time of classification and the rate reduced accordingly. Water-logging is not very common; the remedy is drainage." Is drainage being practised?—Drainage must be carried out in sugarcane cultivation, plantain gardens, and betel-nut gardens.

34. *Q.* Has the necessity been found for making regular deep drainage channels to carry off the water from irrigation?—I am aware of no such work on a large scale.

35. *Q.* Do you know instances where salt efflorescence has come out and been washed away?—No.

36. *Q.* (*Mr. Muir-Mackenzie.*)—Is any drainage done by Government?—I am not aware of any.

37. *Q.* (*Mr. Nicholson.*)—The configuration of the country lends itself to natural drainage?—Yes; there is more or less drainage in all garden cultivation.

38. *Q.* (*The President.*)—As years go by and tanks silt up and sites become less easy to get, I suppose one must look for extension of wells as the real thing to fall back upon?—Certainly I think so; but in my experience wells follow the tanks.

39. *Q.* If there was no tank, there would be no well?—In very many cases; no tank, no well.

40. *Q.* The whole spring level is raised by the tank?—I think so; there are a great many tanks in these provinces which are never used for irrigation; there are no sluices; there are gardens below them and water is only used by percolation; they are exceedingly valuable to the gardens below them.

41. *Q.* Are the tanks of any size?—Yes; they are comparatively large.

42. *Q.* Capable of irrigating 50 or 60 acres?—The ground below is occupied by cocoanuts chiefly; I might instance one locality where that exists near Budihal, south-west of Chitaldrug.

43. *Q.* (*Mr. Ibbetson.*)—Is the benefit that the garden derives merely from the natural percolation, or is a well sunk?—The object is to get the percolation; in every case a well is sunk, a tank is really of benefit to the garden through the well.

44. *Q.* (*The President.*)—Under the circumstances the well need not be a very deep one?—No; as a rule, where wells are dependent on tanks, water is comparatively near the surface.

45. *Q.* Is the "pikota" enough?—Yes.

46. *Q.* Are these wells generally *pakka*?—No.

47. *Q.* Merely holes?—Very often; as a rule, the more a well is dependent for its existence on a tank, the more easy is the sinking of the well and the cheaper is the well.

48. *Q.* It is not worth while to make an elaborate masonry structure?—They don't do it; very often so cheap is the well that they shift its position.

49. *Q.* (*Mr. Ibbetson.*)—Why?—Because, supposing a man has 4 to 5 acres in any part of which a well can be sunk, one well would scarcely be sufficient to let him cultivate easily; therefore he makes two or three; were they expensive wells, he would not undertake so much.

50. (*The President.*)—I suppose you count on getting water within 8 to 10 feet?—Much less.

51. *Q.* Your well is a matter of a few rupees?—Yes.

52. *Q.* (*Mr. Muir-Mackenzie.*)—Is water so near the surface, even in the case of tanks, that have silted up?—Undoubtedly, the silting up of the tank does not affect the water level.

53. *Q.* Even when the tank has gone so far as to be useless for irrigation?—The tank is still beneficial to the well.

54. *Q.* (*The President.*)—You say in paragraph 37 "a well irrigating only one acre when it was capable of irrigating 3 or 4 acres would have a comparatively high rate on that one acre. Conversely, a well irrigating to its full capacity, the rate would be comparatively low." Is the rate liable to be changed from year to year?—No.

55. *Q.* Would a man, irrigating one acre with a well capable of irrigating 3 or 4, go on from year to year irrigating only one. How is the rate fixed?—The rate is fixed per acre, although practically worked out upon the well; supposing a man exceeds that area, it is recorded and nothing more will be charged.

56. *Q.* Or, if he diminishes it, nothing will be reduced?—No.

57. *Q.* Has any mechanical improvement ever been introduced as regards water-lifting apparatus?—I have not seen any.

58. *Q.* Do they use a leather bag with a spout?—On certain wells.

59. *Q.* With a hose at the lower end?—I have not seen the hose.

60. *Q.* You say "a year of scarcity if severe is not a time when people care to engage in constructing wells." In some places the famine of the last few years has given a tremendous impetus to the taking of loans for constructing wells?—I believe that the number of wells sunk during the famine in Mysore was not great.

61. *Q.* You say towards the end of your paper "as bearing upon the question of irrigation so far as it can be affected by the revenue demand, I may mention that the Government of Mysore has most wisely, indeed necessarily, sanctioned an entire re-classification of the water-supply to all irrigable lands. This re-classification is completed in about six taluks and will be incorporated in the revision settlement." That re-classification will take a long time?—Yes; the re-classification will have to proceed, excepting in these six taluks, immediately after the re-survey.

62. *Q.* Is there a settlement going on now in the taluks?—It is just commencing; I am about to submit proposals in the matter for the first two taluks.

63. *Q.* You say at the end of your note "I would say that the true policy for the Mysore Government to adopt in view of the contingency of bad seasons is a thorough repair of tanks, large and small." Would you make them over to the Public Works Department to do?—I believe the Public Works Department are very much opposed to that being done. I don't suggest the means, however the end is attained; the repair of these tanks is most important, because the wells depend upon them.

64. *Q.* Of course you remember Sir Richard Sankey's scheme. At the end of the famine we came to the conclusion that it was too costly to continue; I think his argument was that we should begin at the smallest and make every unit complete in itself. It was held that however valuable this might be, it was prohibitive in point of cost after the heavy losses of the famine. I don't know what has been done since?—(No answer.)

65. *Q.* (*Mr. Higham.*)—You said, if black cotton soil was converted into wet land, it would take several years before good crops were obtained; when that is the case and good crops are obtained, do you think that the profits of cultivation are such as to make it worth while to give up dry

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cultivation? What are the profits of cultivation on irrigated black soil as compared with the profits of dry cultivation? —I don't think the profits on irrigated black soil are greater than on red. I don't think there is anything very exceptional about black soil.

66. *Q.* That would in itself be a reason why people are not anxious to take to irrigation?—I don't think the people know what would happen if they irrigated black cotton soil; they are afraid to undertake it; it is something new.

67. *Q.* In cases where they have taken to it and wet cultivation has been introduced, could you say that they are better off than when they irrigated dry crops?—I think they would be better off. In Yelandur and other parts I have seen very good black soil and very good wet crops. That bears out what I say that it more largely depends on the locality and temper and inclination of the people than on almost anything else.

68. *Q.* (*The President.*)—And the density of the population?—Yes.

69. *Q.* (*Mr. Higham.*)—Are the holdings very large?—In the eastern parts of Mysore the holdings are very large; it is practically virgin soil; they plough it up thoroughly once and then don't plough it for 12 or 15 years; they pull the crops up by the roots, pass a harrow over it, and the soil is ready again.

70. *Q.* That rather affects the question; does it not; even supposing that a man might get a great deal more out of one acre of wet cultivation than out of one acre of dry, the comparison should be made not between one acre of wet and one acre of dry, but between one of wet and two or three of dry?—Quite so.

71. *Q.* They would not convert the cultivation into wet except under great pressure of population?—I think so.

72. *Q.* And sub-division of holdings? —Yes, and the introduction of more skilful cultivators who know what wet cultivation is.

73. *Q.* I have heard of two tanks in Mysore that are in black-cotton soil; one is a very ancient tank, 200 to 300 years old, the Sulekeri; do the people irrigate from that tank?—Attempts to induce people to come and irrigate under the Sulekeri tanks have been practically a failure; land was offered on very favourable terms, but the inducement has not been found sufficient, although the rates are certainly not high; it is not very healthy under the tank; and, as a matter of fact, the cultivators have not come forward.

74. *Q.* May that be taken as a typical instance of the unwillingness of the cultivators to cultivate black soil? —Yes.

75. *Q.* (*Mr. Muir-Mackenzie.*)—Is cotton grown in the soil commanded by the tank? —No.

76. *Q.* (*Mr. Higham.*)—Another tank is of more recent construction—the Kumbakatti; is that a failure too?—Yes; that is a failure for the same reason that the people are disinclined to come forward.

77. *Q.* (*Mr. Ibbetson.*)—I believe that the famine of 1876 is the only one on record as having happened here?—There was great scarcity in 1866.

78. *Q.* Since 1876?—There has been nothing that I should call severe.

79. *Q.* Not even severe scarcity?—No.

80. *Q.* You have said that the province is better protected against famine now than it was in 1877; setting aside railways and the general development of the country, in what degree do you think it is now better protected than it was; has the irrigated area been extended?—By the extension of irrigation more than anything else, without reference to any change in the mode of irrigation.

81. *Q.* Has the extension been great?—There has been a great extension in the channels from rivers; there have been a good many tanks made.

82. *Q.* And wells?—Some wells have been undoubtedly sunk.

83. *Q.* Have these channels from rivers been made by Government or by the people? —By the Government; they are more extensions than new works,—extensions to existing channels.

84. *Q.* Take the new tanks; I suppose capital and revenue accounts are kept for them?—Undoubtedly.

85. *Q.* How far have they paid Government by direct return?—I believe before any tank is undertaken, it is ascertained that the return shall be, at any rate, adequate; I have nothing to do with that; I think the Public Works Department could give the information.

86. *Q.* How far is there room for further extensions in irrigation from channels?—As regards what are called river channels, almost all we have are led from the Cauvery and Hamawattee. (Addressing President.) In 1878, when you were here as Officiating Chief Engineer, you questioned the amount of concealment in river channels; the area was put at 47,000 acres, and that area was supposed to be irrigated; my department then took up the work and the figures now are 73,000.

87. *Q.* I mean is there any room for further expansion?—I think that must be gauged from the area irrigated, which is 73,000 acres.

88. *Q.* Do you think the 73,000 can be increased?—I think so.

89. *Q.* (*The President.*)—Do you mean that since 1878 channel irrigation has extended from 47,000 to 73,000?—The 47,000 acres have been ascertained to be really 73,000; the increase is chiefly due to concealments; 50 per cent. excess has been discovered and the profit of course has been very great.

90. *Q.* (*Mr. Muir-Mackenzie.*)—No great extension of actual cultivation has been made apparently?—There has been a good deal; undoubtedly there has been extension of channels.

91. *Q.* (*Mr. Ibbetson.*)—Do you think a further substantial extension is possible?—Not a very large amount; a moderate amount.

92. *Q.* As regards tanks, is there room for extension there?—I should say there is less room, because every available spot has been taken up; anybody, looking at a typographical map for sites for tanks to find out where he could make them, would find himself forestalled everywhere.

93. *Q.* Is there a large proportion of tanks silted up so as to be practically of no use for irrigation?—No doubt a large number are silted up and a good many are not used for irrigation.

94. *Q.* What I wanted to know was how fast the process of silting up is going on?—I cannot say.

95. *Q.* You have not derived any idea of the life of a tank from what you have seen?—No; I have not attempted to form an opinion.

96. *Q.* When your tanks are silted up, you say there are no more sites available?—There must be very few.

97. *Q.* The reason that you cannot expand being not that the water is all used up, but that there are no unoccupied sites?—Yes.

98. *Q.* You said there are parts where black soil is irrigated successfully; what is the depth of the soil in those parts?—I should say it was very deep.

99. *Q.* That is to say, more than 3 feet?—Certainly.

100. *Q.* What do they grow there?—Rice, sugarcane, wheat, and onions, garden crops generally.

101. *Q.* Is it what you would call high class black soil? —There are gradations; I should call it high class; black soil for garden crops is more workable than when used for rice.

102. *Q.* Why? —They can divide the land to be irrigated into little plots which are more under command; it would be impossible to flood a large extent of black soil; whereas little divided compartments could easily be manipulated; for this reason black soil is more favourable for garden cultivation than for rice.

103. *Q.* You spoke of the extreme reluctance on the part of the ryots to attempt the experiment of irrigation on black soil; has such irrigation extended at all while you have been in the province?—I am not aware of it.

104. *Q.* You don't know a place where they used not to irrigate when you came here, but where they have taken it up since?—I don't know of any black soil being taken up for irrigation on a large scale.

105. *Q.* (*Mr. Muir-Mackenzie.*)—Do you know of other classes of soil being taken up?—Yes.

106. *Q.* (*Mr. Ibbetson.*)—What is the rule with regard to enhancement of assessment where a man who is paying dry assessment makes a tank?—The course is this: his land is assessed at a water-rate of Rs. 4; but in consideration of having constructed a tank and maintaining this tank one-fourth is remitted; he is not liable to enhancement except in so far as the full rate may be altered or reduced.

107. *Q.* You say that three-fourths of the wells in the province are directly or indirectly dependent on tanks; does that mean that the areas where wells can be made apart

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from tanks are limited?—I think myself that tanks are a great deal older than wells; wells are sunk below the tank.

108. *Q.* Supposing you have a tank from which you have channels and can irrigate the land, and under that tank there are a number of wells using the under-ground storage. Your channels enable you to distribute the above ground storage; do you, in order to avoid using two sources of supply on the same land, carry the direct irrigation from the tank beyond the wells and supply it to land on which there is no well; or do you give the direct supply to the same land that the wells are already made in?—As a rule, it will be found that where wells exist they don't use the water from the tank; in that case the water passes to what we call wet land.

109. *Q.* That is the rule?—Yes; now and again we find that a man uses both supplies, but that is not usual.

110. *Q.* Do you do anything to prevent him using both sources of supply so as to economise the water?—Sometimes a man has got a piece of land situated under a tank in which he has a well to which tank water can also be given, that man, during the currency of the settlement, says I want tank water too; in that case inquiries would be made, whether, looking at the requirements of the others, he can receive the water. Very often it is decided he must go on cultivating without it.

111. *Q.* You would give the preference to a man without a well?—Yes, as a rule.

112. *Q.* (*Mr. Higham.*)—Are wells ever abandoned for tank water?—Very rarely.

113. *Q.* What is the reason?—Because he prefers his well water to any other water; he likes his own supply which cannot be interfered with. He would prefer a small tank to a big one.

114. *Q.* (*Mr. Muir-Mackenzie.*)—Which assessment is higher?—*Bagait* is higher, because Government have always claimed their share of what is called superior produce.

115. *Q.* (*Mr. Ibbetson.*)—Supposing you had half a lakh of rupees to build wells with, how do you think you would do most good to the people and protect them effectually by building these wells in dry lands where they have no means of irrigation or sinking them under tanks where they already have water available?—The tanks have taken up all the good sites; it is very improbable that you would find any good sites for wells.

116. *Q.* There are hardly any places where wells could be sunk with advantage?—I think there is very little suitable ground left for sinking wells.

117. *Q.* Do the villagers regulate the distribution of water from tanks themselves?—It is done by the *nirganti.*

118. *Q.* Are there many disputes?—I have heard of very few.

119. *Q.* I have heard elsewhere that if a tank does not fill up, so that the supply will not be enough for the land which requires water, the people will not use any of the water, because they cannot decide who is to use what there is?—I have not heard of such a case.

120. *Q.* Do you doubt if that is the case?—It is not in my experience.

121. *Q.* I understand that your revenue on wet land is a consolidated revenue,—paid whether they take water or not?—Yes.

122. *Q.* Even if a tank is empty, they will pay their regular assessment?—Yes.

123. *Q.* You say it is most difficult to get people to do the petty repairs of their tanks; is there any sort of penalty which can be imposed, making a man pay double the value of the labour, or anything of that sort; is there any law to that effect?—I am not aware what power Government has; it is laid down in the old standing custom of the country.

124. *Q.* Who has charge of that work: the Public Works Department or the Revenue authorities?—I think it is a dual management. I have nothing to do with it.

125. *Q.* With regard to advances, Government advances were common enough before the introduction of the new rules?—Yes; I think the rules were framed more because the Code laid down that certain rules should be framed; advances were made before under working rules.

126. *Q.* Do you know anything about them or their working?—I have had nothing to do with them.

127. *Q.* Have you heard people talking about the terms on which Government money is advanced; do you know any points on which they complain?—I have heard no complaints.

128. *Q.* You say new wells diminish the supply of old ones?—In making that remark I had in view some independent wells, not tank-fed wells.

129. *Q.* Can you give any idea of how near it is safe to build wells to one another without risk of their interfering with one another's supply? How many wells could you put into 50 acres, for instance?—It would depend entirely on the water stratum; in wells under tanks there might be any number; where wells are dependent on springs you could not exceed one well for 5 or 6 acres; otherwise there would be danger of their robbing one another.

130. *Q.* Is there any system in Mysore of giving a man who constructs a new irrigation work an *inam,* say one-tenth share of the returns of his holding?—There used to be a one-fifth share allowed or *panch-hissa;* now it has been changed to one-fourth remission.

131. *Q.* Were there many works constructed under that old *panch-hissa* rule?—There were a great many.

132. *Q.* What was it exactly?—A man got off one-fifth of the whole assessment.

133. *Q.* Have you ever heard the abolition of the old *panch-hissa* rule regretted?—No.

134. *Q.* I understand the old *panch-hissa* rule was a share of the returns from his holding?—I cannot say for certain; I think it was in the same nature as the present rule.

135. *Q.* We have been told that the wet lands under tanks are mainly held by the richer and non-agricultural classes, and that the poorer cultivators will not take them up, because they are afraid of the risk of bad years; is that your experience?—It is my experience entirely with reference to the channel lands which are altogether in the hands of capitalists; it would not apply to tanks.

136. *Q.* How did they come into the hands of capitalists?—I think in many cases they were acquired by Brahmins who watched their opportunity of getting them.

137. *Q.* Are the channel lands particularly valuable?—Very valuable.

138. *Q.* Do you think that applies to channel lands only?—Yes.

139. *Q.* (*Mr. Muir-Mackenzie.*)—You say that there are no lands more prized than well-irrigated lands, and yet I understand that the rate on well lands is higher than the rate on rice lands?—I don't think the rate is higher for the reason I explained; the acreage rate may appear higher, but it is really not higher.

140. *Q.* I understood you to say that it was the custom of the State to take a share of the more valuable produce, and that that made the assessment higher?—I was alluding chiefly to the betel-nut gardens on which the rates are very high, simply because the Government have always had their share of the superior produce; and not only that but the export duty is 25 per cent. higher than the land assessment.

141. *Q.* Still I imagine it is true of these lands as of other well-irrigated lands that no lands are more highly prized?—Yes.

142. *Q.* And on no lands is the assessment more easily paid?—Yes.

143. *Q.* In a year of famine is it the case, as in 1876, that the great majority of the tanks would be empty?—Yes, I think so.

144. *Q.* I don't understand how, except in the mere matter of river channels, the country is better protected now than it was then by the extension of irrigation?—It is only protected by increased crops. Apart from land under channels, I don't think I could say there has been any very great change.

145. *Q.* But even the new tanks would be empty; would they not?—Yes, that is likely.

146. *Q.* I mean in time of famine would the protection be any greater than it was in 1876-77?—Only by increased produce under channels.

147. *Q.* (*The President.*)—I suppose there would be some increase under wells?—No doubt.

148. *Q.* (*Mr. Muir-Mackenzie.*)—Now, as regards the silting up of tanks and its being impossible to use them for irrigation, would you say there are fewer tanks in effective operation now than when you came here?—No; taking the condition of the tanks and everything into account, they are

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about the same; some have deteriorated and some have improved.

149. *Q.* The water-supply would have improved in some places and deteriorated in others?—Yes.

150. *Q.* You say six taluks have been re-settled?—Yes.

151. *Q.* What has been the result; has it shown a general improvement on the average?—I kept the water classification which was sanctioned by the Mysore Government in abeyance, so that I make use of it, although it was carried out some years ago. I am not able to tell you the result.

152. *Q.* Not even in two taluks?—I don't see very much change.

153. *Q.* (*Mr. Ibbetson.*)—By "change" you mean extension of irrigated area?—Yes; I don't think there is an increase.

154. *Q.* Is it the case that, although the irrigated area has not been extended, the supply has become so certain that you could put on a higher assessment?—I don't think so.

155. *Q.* (*Mr. Muir-Mackenzie.*)—You are convinced that it is advisable to go on with the revised classification?—I think it is absolutely necessary in the interests of Government and of the rayat.

156. *Q.* I am anxious to get at a clear idea of whether the black soil in Yellandur, which yields very good wet crops, is true black cotton soil?—Yes.

157. *Q.* Has it deep cracks?—Most of the black soil is under irrigation; I cannot say I have noticed particularly whether these cracks remain. I cannot speak positively.

158. *Q.* Is it very deep?—I should say so.

159. *Q.* Does black soil when under irrigation take more water than the other soil?—I am unable to say. I should think it would take a great deal more water.

160. *Q.* You allude to the practice in several taluks of Chitaldrug of running up embankments in favourable spots, not to hold water, but to collect silt and soil. Were there many of these made in the great famine?—Yes; they have been there from time immemorial.

161. *Q.* Did the lands behind them yield crops?—Yes, certainly; I think some crops were to be found there when they could not be found anywhere else.

162. *Q.* Could famine relief labour be profitably employed in making more of these embankments?—No, because the initiative is invariably taken by the occupant of the soil himself. I don't think you could find out where they could be advantageously constructed.

163. *Q.* Not by a survey?—No, I don't think so.

164. *Q.* Still advances might be given liberally?—There are very few sites left; they are very valuable.

165. *Q.* I understand no remissions are given on account of failure of water in the tanks?—No, because the assessment was based on an average; cases in which a remission is given is where the tank breaches.

166. *Q.* Are you satisfied with the working of that system?—Yes, if judged by results and by watching the working of the settlement since it was introduced, I don't think the system is a bad one.

167. *Q.* You don't think the rayats have had difficulty in paying their assessment in bad years?—The only way one could judge is by the land under occupancy; it has not gone back.

168. *Q.* Has the land under occupancy increased?—Yes, I think it has increased.

169. *Q.* (*Mr. Rajaratna Mudaliar.*)—Do you mean the irrigated area?—Yes.

170. *Q.* (*Mr. Muir-Mackenzie.*)—Will you kindly indicate some particulars regarding the more liberal policy you spoke of in the matter of well-irrigated land?—The general idea in respect of wells which were in existence at the original settlement thirty years ago and which have been assessed is to reduce that assessment to the highest dry crop rate, the same as in Bombay, except that I think nothing quixotic will be done; a great difference will be made between places where the water is far away and those where it is near the surface; it would be madness to treat them alike, and I think it would be quixotic on the part of Government. In Bombay their policy went far beyond their pledges; they said that no improvements made during the currency of the settlement should be taxed during the settlement, but they said nothing about lands that were in existence at the time of the settlement; they took up the first taluk and started a policy which went far beyond their own terms; they reduced the assessment which was in existence at the first settlement to the highest dry crop rate and wells which were made during the currency of the settlement they assessed at simply dry rates; then on a well under the *ayakat* of a tank they said we will take double the highest dry crop rate; that would mean taking a great deal; there is no limit if this is done. I don't think this Government will ever strictly follow the Bombay principle.

171. *Q.* You don't think they will go as far as Bombay?—They will be more liberal; certainly they won't ignore wells which are dependent on tanks and Government works; they must impose a different system there.

172. *Q.* (*Mr. Rajaratna Mudaliar.*)—You say that in the case of wells in wet lands the assessment is double the ordinary dry rate?—No.

173. *Q.* Is it proposed to do that?—No revision has yet been carried out.

174. *Q.* Is it proposed to adopt that policy of charging double rates for wells in wet lands?—I think not. I merely mentioned it by way of illustration; nothing has been settled in Mysore.

175. *Q.* What has been the increase in irrigated area under tanks; do you happen to know?—I said I thought there had been an increase in the irrigated area under tanks, but I could not give you figures.

176. *Q.* Could you say, roughly, what is the percentage?—I believe there has certainly been an increase. I am unable to give figures.

177. *Q.* Was it due to the construction of new tanks or the repair of old ones?—I have no accurate information.

178. *Q.* Can you say for certain there has been an increase?—Certainly.

179. *Q.* Notwithstanding the fact that no attention was paid to the repair of minor tanks?—Yes, there has been an increase.

180. *Q.* During the past 30 years, do you know whether much has been spent on the repair of these minor tanks?—I know a good deal has been spent; I think if you inquired from the Public Works Department, you would find that that is so.

181. *Q.* On large projects enormous sums have been spent, but not on minor projects?—I don't know; I could not give you accurate information.

182. *Q.* Does your assessment include one anna in the rupee as an irrigation cess?—Yes, one-seventeenth of the assessment is deducted and credited to the Irrigation Fund; that is merely on paper just now; it was manipulated by Government as an Irrigation Fund.

183. *Q.* Is it assigned to each village or group of tanks?—No; it is not assigned minutely in that way; it is taken into a general fund and manipulated.

184. *Q.* It is not set apart for expenditure on particular works?—No.

185. *Q.* Can you say, roughly, what is the average wet rate under tank irrigation, taking all the tanks together?—The average would be Rs. 3-8-0 roughly. A high class tank would be Rs. 5 or Rs. 6, and it would go down to Rs. 2.

186. *Q.* Are there not villages in Mysore situated close to British territory in Cuddapah?—Mysore territory is adjacent to several villages in Cuddapah. I don't know the exact part you allude to.

187. *Q.* I remember several villages in which your rates are higher?—Possibly.

188. *Q.* And in British villages remission is given though not in Mysore. On what grounds is remission not given?—Because the capability of the tank has been taken upon the average of a number of years.

189. *Q.* In what way have you allowed for vicissitudes of seasons in fixing rates?—On a tank which has filled once in two or three years we have put a very low assessment.

190. *Q.* You take the old assessment and reduce the rates?—Perhaps reduce or raise.

191. *Q.* In the taluks you have settled, have you reduced the old assessment?—Yes.

192. *Q.* To what extent?—I cannot say in detail; if you were to take 300 villages, you would probably find 50 to 60 reduced.

193. *Q.* Was that done owing to the policy of lenient settlement or with reference to the precariousness of the

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supply?—Having regard to all the circumstances of the country and also looking at the past revenue and collection, in a great many villages it was probably raised, but in a considerable number it was reduced.

194. *Q.* Has there been any re-settlement since the original settlement?—No.

195. *Q.* Is any contribution levied from cultivators under tanks in order to carry out repairs to such tanks?—There is only the irrigation cess.

196. *Q.* As regards smaller works, is the repair left to the cultivators themselves, or does Government carry out the repairs?—I believe, in the case of minor tanks, the rayats are supposed to keep them under repair.

197. *Q.* What is the limit?—I think it is judged by the revenue. If the revenue is less than Rs. 300, it is considered a minor tank.

198. *Q.* Have all such tanks been repaired and handed over to the rayat?—No.

199. *Q.* In such a case is the irrigation cess remitted?—It is included in the assessment and is certainly not remitted.

200. *Q.* Although the rayats are called upon to keep them in order?—No, not even in consideration of that.

201. *Q.* You said that when there is a well in an *ayakat*, you don't allow the rayats the use of the tank water?—We allow him to use it if at the time of classification he was using it. When we did our classification, we assumed that that man always cultivated his garden by the aid of his well; but Government would take the exising state of things into consideration and fix the assessment; if a man said I wish to use my well and also the channels, it would be a moot question whether the authorities would allow it.

202. *Q.* Supposing he was using the water at the time of the settlement, how would you classify his land, as wet, or garden?—As garden. We classify it upon the existing state of things.

203. *Q.* Supposing he did use the tank water in addition to his own well, would you impose anything extra?—I suppose it would be reported and some order passed upon it.

204. *Q.* What is there to prevent him using this water?—No doubt it would be brought before the officer for orders and he could be fined, of course; but I imagine he probably would not be; some arrangement would be made about letting him have the water and changing the assessment.

205. *Q.* You said the assessment on garden land is fixed on the well, not on the area?—I meant to say that it is recorded as so much per acre; but there is no doubt that the area under a well pretty well regulates the total amount you put on the well; it is more as if you put an assessment on the well for what it could irrigate.

206. *Q.* In the settlement you assess so many acres as irrigable by a well and the rate is fixed on that?—There is no fixed mode of dealing with it in that way; the rates may seem very high, but they are really not very high.

207. *Q.* You say that the rate varies from Re. 1 to Rs. 8; does it go as low as Re. 1?—Yes, in Chitaldrug we constantly place Re. 1 per acre on well-irrigated land.

208. *Q.* Garden land?—It is only called garden land, because it is under a well; the rate is fixed actually by the Settlement Officer.

209. *Q.* What is the highest rate per acre on each garden?—In the betel-nut gardens it goes as high as 16 or 18; that is quite special produce; before our settlement was introduced it used to be 40.

210. *Q.* Now it seldom exceeds 16 or 18?—Yes.

211. *Q.* Do you charge on the crop; supposing a betel-nut garden is destroyed and other crops are raised, do you reduce the assessment?—No doubt a change would be made.

212. *Q.* Before the expiration of the settlement?—If a case occurred, no doubt it would be taken up; in one taluk which was completely re-classed there was scarcely any change whatever; the gardens were just the same as they were thirty years ago; the changes are ridiculously small.

213. *Q.* But if a change did occur, you would take that into consideration?—No doubt.

COLONEL D. McN. CAMPBELL, R.E., Chief Engineer in Mysore.

(Bangalore, 18th January 1902.)

Memo. by witness.

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The total amount expended on irrigation works since 1881 has been Rs. 2,06,70,419. The revenue during the same period is approximately Rs. 3,50,00,000, so the outlay has been recouped and a balance left of 143 lakhs.

Method of dealing with tank restoration and repairs.

Ever since about 1868 the necessity for dealing with tanks serially has been advocated. It is evident that when there is a series of tanks, the repairs and restorations should commence at these upper tanks; for if one of them breaches, it is likely to breach the one below, and so on, till the whole series might be destroyed. Consequently, after the formation of the Irrigation Department, serial maps and registers were prepared giving full details of all the tanks.

This was necessarily a work of time; and, on the abolition of the Irrigation Department in 1879, 18 series had been dealt with, one alone, the Ramasagara, consisting of about 1,000 tanks. Nothing has been since done in this direction, and the tanks have not been dealt with serially; but are taken up in order of importance, and when there is scope for enlargement and remunerative returns. The terminal tank of each sub-series is made so strong as to withstand the breaching of the tanks above and is called a stop-tank.

The work involved in preparing these maps and registers, as was done in the time of the Irrigation Department, is immense; not only were the tanks all mapped out by series and sub-series, but detailed information was entered in the register about each tank, such as capacity, waterspread, *ayakat*, etc.; a description of the masonry works was also given, as also an estimate prepared for putting each tank in complete order.

It may safely be assumed that one man could not survey a tank and prepare all such information accurately under two weeks; the 39,000 tanks in the province would therefore take one man 78,000 weeks or 1,500 years, and 100 men 15 years.

The question arises:—Is it necessary to obtain all this information to keep the tanks in order, or is it even advisable? For it must be remembered that an estimate prepared at the beginning of the operations would be useless at the end of them, or 15 years later! All that is necessary, it seems to me, is to have maps prepared showing all the tanks serially, and give each a registered number.

After the maps are prepared, a certain number of tanks at the head of each series could be taken up and estimated for; and in connection with the framing of the estimate for these, details as to capacity, *ayakat*, etc., could be got.

To prepare such maps with the help of the topographical maps would not take over a year, if a small special establishment were employed. I have several times advocated this, but never could find the establishment to carry out the work, and an extra establishment could not be granted.

Upkeep of tanks.

The most important matter connected with tanks is their upkeep with reference to the agency by which the work is to be done.

This matter has been the subject of a lengthy correspondence ever since the year 1862, and it is not yet by any means satisfactorily settled.

After a great deal of discussion, rules for the maintenance of tanks were issued by the Commissioner of Mysore in October 1873. The gist of these rules is that the village authorities were held responsible for the maintenance and upkeep of all tanks that were handed over to the rayats on or after that date; and in case it was afterwards found on inspection that any tank had not been kept up to the standard to which it was brought up when handed over, the work should be carried out by the Amildars, and the cost recovered from the defaulters as a revenue demand.

After the rendition in 1881, all orders in force before held good unless specially rescinded, and therefore these rules of 1873 are now in force as regards maintenance.

In 1885-86, the minor tank system was introduced, by which all tanks yielding a revenue of Rs. 300 and under were called minor, and were restored by the rayats under the civil authorities, only stone-work and masonry being done by Government. Tanks yielding more than Rs. 300 revenue were classed as major, and the restoration is carried out by Government. As each tank, whether major or minor, is restored and brought up to a certain standard (which varies according to the importance of the tank), it is handed over to the civil authorities, and they are expected to see that the rayats obey the rules of 1873 as regards maintenance.

If these rules were carried out, everything would be very simple; but, unfortunately, the rayats seldom make any effort to keep their tanks up to standard, and the result is that the majority of the restored tanks are gradually deteriorating.

I cannot say whether the Commissioner of Mysore was authorised to issue his rules of 1873, and whether the rayats can legally be forced to keep their tanks in order, failing which the cost of the work necessary can be recovered as a revenue demand.

There seem to be doubts on this point; anyhow the penalty is, I believe, not always enforced, except in the case of tanks affecting the safety of railways.

This state of affairs is most unsatisfactory, as the rayats will not keep these tanks in order and cannot be made to do so.

The rules are, in fact, so much waste paper, and will be so till they can be legally enforced and some penalties inflicted for disobedience.

The difficulties connected with the subject can be seen by a perusal of the large file of correspondence; but however great the difficulties, they will have to be overcome, as otherwise the tanks will deteriorate more and more, and the best way of settling the matter will be to appoint a committee of officers experienced in the subject to draw up rules; but as I have already said, these rules will be of no use unless they have the force of law.

It is of course impossible for the Public Works Department to maintain 29,000 tanks up to standard without the establishment being enormously increased, while for the rayats to maintain the tanks themselves is a very simple matter, and would probably not give them more than one or two days' work each year.

To facilitate the work being done by the rayats, each tank after being brought up to standard has gradestones fixed on the *bund* showing the height it should be, and the correct top width is also marked by stones.

The establishment employed on the minor tank scheme consists of one sub-overseer, one clerk, and one peon for each district, and one tank inspector for each taluk. The cost is about Rs. 18,000 per annum and is borne by the Public Works Budget.

The estimates for both earthwork and masonry are prepared by the tank inspector if under Rs. 500 and by the Executive Engineer if over Rs. 500; the former are sanctioned by the Deputy Commissioner and the latter by the Superintending Engineer.

Tank *bunds* generally deteriorate by rainfall, and the treading of cattle, which reduces the height and width, and to keep the *bund* to standard would require very little attention on the part of the rayats; but instead of giving the tanks that little attention, they allow them to go from bad to worse till they breach.

In 1899 the number of minor tanks dealt with by the rayats was 1,137, and earthwork valued at Rs. 78,749 was carried out, giving an average of about Rs. 70 per tank, and the sum expended on masonry works to these tanks by the Deputy Commissioners was Rs. 24,482.

The tanks in the Ramasagara series were brought up to standard years ago and handed over to the civil authorities; but many of them have had to be repaired since, and I am told that the *bunds* of numbers of them are now 2 feet or 3 feet below grade-level.

The remarks regarding the up-keep of tanks refer also to the feeder and distribution channels connected with these tanks, which are also much neglected by the rayats. Many different remedies for this state of affairs have been proposed, which it is unnecessary to discuss here; and the formation of a committee, as I have often advocated, is the only satisfactory solution of this question, which largely affects the interests of the State.

Restriction as to the formation of new reservoirs.

Besides the restrictions on the extension of irrigation, already mentioned as embodied in the "Rules laid down with Madras," there are 45 streams in the province across which no new reservoir is to be constructed within distances varying from 4½ to 46 miles measured upstream from the Madras frontier. There are several good sites for reservoirs within the limits laid down, but it is possible that the Madras Government may object to their construction.

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Well and spring irrigation.

The Public Works Department has nothing to do with the irrigation from wells and springs, but the following information has been received from Deputy Commissioners:—

In Chitaldrug district there are 6,339 wells irrigating 15,576 acres and yielding a revenue of Rs. 36,134.

Under a notification of Government, dated 21st July 1891, grants of advances carrying interest at 3 per cent. are made to the rayats for digging wells. This has largely been taken advantage of, and since the date of the notification, Rs. 1,35,724 have been advanced and 608 wells sunk, of which 396 have been completed, and the remainder are in progress.

These wells have been of great benefit to the rayats, and it would no doubt be advantageous if more were sunk. There are only 7 acres irrigated by springs.

In the Shimoga district, in the Malnad parts, wells, as a source of irrigation, are only used to a very trifling extent for supplying water to sugarcane.

In the maidan taluks of Channagiri and Honnalli and the maidan portion of Shimoga there are a few wells used for irrigation purposes. The total number is 274, and they irrigate 512 acres, yielding a revenue of Rs. 2,631.

In the Kadur district there are no wells or springs.

In the Bangalore district there are 211 private wells constructed on loans from Government, irrigating 594 acres and yielding a revenue of Rs. 1,032.

There are, besides, 6,748 other private wells irrigating 5,332 acres and yielding a revenue of Rs. 16,641. There is also one Government well irrigating 1 acre 12 guntas and yielding Rs. 5 revenue. The total is therefore 6,960 wells irrigating 5,927 acres and yielding a revenue of Rs. 17,678.

In the Hassan district there are no wells, but about 407 acres of land are irrigated by springs and with an assessment of Rs. 1,471.

In the Kolar district there are 2,388 Government irrigation wells irrigating 2,981 acres and assessed at Rs. 7,807. There are 200 wells constructed under loans from Government, irrigating 399 acres assessed at Rs. 926, and 12,490 private wells irrigating 4,758 acres and assessed at Rs. 26,223. The total is therefore 15,078 irrigating 8,141 acres and assessed at Rs. 34,956.

The Deputy Commissioner states that these wells are very beneficial even in seasons of drought, but that the rayats have not largely taken advantage of the concession granted by Government as regards loans.

In the Tumkur district there are 296 wells constructed on loans from Government and 11,929 other wells, making a total of 12,225. The total area irrigated by wells alone is 17,567 acres assessed at Rs. 74,007.

There are 310 Talaparigis or springs irrigating 4,584 acres assessed at Rs. 24,300.

In years of drought the supply of water in the wells and springs gets generally diminished, but does not altogether fail except in rare instances; and in these cases the wells are deepened either by loans from Government or by private capital, and generally about half the usual lands is then brought under cultivation.

In the Mysore district the area irrigated by springs is 1,987 acres assessed at Rs. 5,730.

(NOTE.—The area and assessment given above appertain to lands irrigated exclusively by wells.)

The following table gives the total cultivation for 1899-1900 in the province as taken from the Mysore Atlas of 1900:—

District.	Wet acres.	Dry acres.	Garden acres.	Total acres.
Bangalore . . .	56,341	574,803	20,179	651,323
Tumkur . . .	66,458	834,637	72,596	973,691
Kolar . . .	65,676	383,059	30,677	479,412
Mysore . . .	110,045	1,268,318	28,903	1,407,266
Hassan . . .	111,566	580,358	25,227	717,151
Shimoga . . .	227,748	89,640	18,069	335,457
Kadur . . .	108,166	364,061	19,003	491,230
Chitaldrug . .	27,682	1,091,408	28,957	1,148,047
Total .	773,677	5,317,508	243,611	6,334,796

N. B.—This does not include coffee, cinchona, and cardamom.

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The area of the entire province being 29,365 square miles or 18,793,600 acres, the proportion of cultivated land is 33·7 per cent., the proportion of dry cultivation being 28·3, of wet 4·1, and of garden 1·3.

It is stated in the Mysore Atlas of 1900 that the cost of living per mass of the population is Rs. 3 per head per month, or Rs. 36 per annum.

The net value of the produce of 1 acre of dry cultivation may be taken at Rs. 11, of wet at Rs. 70, garden Rs. 120. Consequently the total value of the crops in an ordinary year is 7,73,677 × 70 + 53,17,508 × 11 + 2,43,611 × 120 = Rs. 14,18,83,298.

The agricultural population (adding 10 per cent. to the Census for 1891) is 3,499,752, and therefore the value of the produce is equal to a little over Rs. 40 per head.

The margin is therefore very small, and I am inclined to think that either the area of cultivation or value of the produce (always most difficult to ascertain) is under-estimated.

It would be interesting if calculations on these lines could be accurately worked out as the resources of the country as regards food-grains would then be known.

I have given the foregoing information regarding irrigation works and areas of cultivation and revenue, etc., in this province, in hopes that it may be of some interest to the Commissioners, and may enable them to form some opinion as to the capabilities of the present works as a protection against famine, and I will now proceed to touch on the subjects which form the *raison d'être* of the Commissioners.

These subjects are—

(*1st*) the character and utility of the existing programme of relief works, and the arrangements permanently required for reconstituting these programmes, and for maintaining them in the most efficient manner;

(*2nd*) whether any opportunities exist which are at present not utilized, or are very imperfectly utilized, for minor canals, storage reservoirs, and other irrigation works on a comparatively small scale, which may or may not be "productive" in the technical sense of the term, but which will afford material protection from droughts;

(*3rd*) the utilization of hill streams, or the formation of storage reservoirs;

(*4th*) improvements in the matter of well irrigation, and whether Government might not give more assistance to owners and occupiers in this respect by means of loans, and by expert advice, or by grants-in-aid from the annual famine grant.

As regards No. 1.—The total population of the province, adding 10 per cent. to that given in the Census Report of 1891, is 5,327,875.

The population of the area not liable to drought is (adding 10 per cent. to the number given in the Census of 1891) 1,595,295. The balance remaining is therefore 3,732,580.

It is laid down by the Director of Statistics, Mysore, in his memo. of 21st February 1900, that sufficient small works should be provided to afford employment for 10 per cent. of the population for six months, and sufficient large works for 10 per cent. of the population besides, for three months.

These calculations are made with reference to the numbers on relief in previous famines.

If these figures are accepted, and I think it possible that in a bad famine such as 1876-77 relief might have to be afforded to the full number, it means that employment must be found for 373,258 persons for six months, and for another 373,258, for three months more.

The amount that each person will earn is generally taken at Rs. 3½ per month, or Rs. 21 for six months.

The amount of the estimates to be entered in the famine programme for small works (that is, minor irrigation works and village works, both of which might be carried out by civil officers) must therefore be Rs. 78,34,418, or over 78 lakhs; and the amount entered for large works (to be carried out by the Public Works Department) must be Rs. 39,19,209, or over 39 lakhs. Consequently works costing the enormous sum of 117 lakhs must be estimated for and entered in the famine programme.

I will now consider the number of relief works required.

There are altogether 333 hoblies (a collection of villages) liable to famine, and the Director of Statistics recommends that there should be at least two small works for each hobli, and three or four would be better; if three are allowed, the number of small works required would be 999, say 1,000, and the average cost of each $\frac{7834418}{1000}$, or Rs. 7,838.

There are altogether 38 entire taluks and 21 parts of taluks liable to drought; and it is recommended that there should be three large works for each whole taluk, and two for each portion of a taluk.

The number of large works should therefore be 38 × 3 + 21 × 2 = 156, and the average cost of each $\frac{3919209}{156}$ = Rs. 25,125.

There has therefore to be provided (*a*) 1,000 works costing Rs. 7,838 each, (*b*) 156 works costing Rs. 25,125 each.

Now as regards (*a*).—The question arises, how so many works costing a large sum each are to be found; the only small works that could be carried out are village relief works, and the restoration and repairs of minor tanks. Village relief works generally consist of filling objectionable pits and ditches, clearing prickly pear, deepening ponds and wells, and constructing new wells, etc.; and it is very seldom that the estimate for any one of these items exceeds Rs. 200.

The number of minor tanks in the province is 26,500, and it is possible that useful work might be found in connection with 10,000 of these; but the amount of the estimate for each would certainly not exceed Rs. 500, so that the total amount of the estimates would be 50 lakhs, leaving 28 lakhs for village relief works; and as it has been stated that the average estimate for each of the latter works will not exceed Rs. 200, there will have to be 14,000 such works. Thus, in time of famine, there would have to be 10,000 small public works (minor tanks, etc.) and 14,000 village relief works in progress, and the amount of supervision that would be required would be enormous; and I believe it would be quite impracticable to carry on relief in this manner.

It must also be considered how long it will take to prepare estimate for 10,000 minor irrigation works, and that if estimates are prepared now they will be almost useless a few years hence.

As regards (*b*).—The difficulties are not so great. There are about 1,013 major tanks yet to be restored, and it would no doubt be easy enough to select 156 of these estimates for restoration, each of which would average Rs. 25,000. There would, besides, be new works which may cost from Rs. 25,000 to several lakhs each, but the estimates for all of these will necessarily take several years to prepare. It is therefore probable that in five years enough estimates for large works, such as restoration of major tanks, and the construction of new ones, to afford all the relief necessary, will be ready.

Referring again to small works, I have shown that the proposals are almost impracticable owing to the impossibility of adequate supervision. Village relief works are of course necessary to provide help to those who seek, or who have to remain in their homes to attend to cattle and other domestic matters.

As regards large works, I doubt exceedingly the advisability of employing famine labour on works requiring professional skill, and no works require so much care in construction as earthen reservoirs; and I should be sorry, as an Engineer, to be responsible for the safety of an earthen dam to contain any great depth of water, if it was constructed by famine labour; but if carried out under professional supervision, and under the usual public works rules, that would be a different matter. Another point to be considered is that a severe famine would probably so cripple the resources of the State that it would be impossible to complete all the large irrigation works that had been put in hand.

In times of famine I would therefore—

(*1st*) increase the ordinary public works to the greatest extent possible, starting some of the large new works entered in the programme so as to give employment to all kinds of labour. All these works should be carried out under professional supervision and as in ordinary times, except that the rates should be increased in proportion to the cost of food-grains, the excess being charged to famine;

(*2nd*) start village relief works for such as cannot leave their villages, supplemented by many minor irrigation works as can be *properly* supervised;

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(*3rd*) (*a*) collect road metal, spreading when required, and dig side drains;

(*b*) dig channels from tanks; and

(*c*) carry out railway earthwork.

No. 1 would be under the ordinary public works establishment of the province;

No. 2 under the civil authorities;

No. 3 (*a*) under officers, whether professional or not, borrowed, if necessary, from other States; (*b*) and (*c*) under professional officers obtained from other States if necessary.

I consider that preparing metal for roads, spreading it when required, and digging side and check drains is the very best form of relief work. An estimate for collecting metal for many miles of road can be prepared in a day without any levels or preliminary investigation. The metal, when collected and stacked at the site of the road, is useful for many years to come. The work is suited to the most unskilled labour. The supervision is comparatively easy. There is generally a network of roads, so that nearly every village is within reasonable distance of one. The expenditure, though considerable, will save a large portion of the expenditure on the up-keep of the roads for several years afterwards. Fewer tools are required. It gives employment also to carts for the carriage of the metal. Camps can be more conveniently formed.

In this province good stone is found close to nearly all the roads.

After the experience of three famines in the Madras Presidency, I have come to the conclusion that preparing road metal is generally the best way of employing famine labour. Making new roads is in most cases a mistake, as they often cannot be maintained afterwards; though of course if the formation of a road has been decided on and it has been ascertained that funds will be available for its future up-keep, then it is a very good form of relief work.

I have not lost sight of the fact that the restoration and repairs of existing irrigation works has the double advantage of affording employment to the distressed and of being to a certain extent a protection against famine, and that therefore as much labour as possible should be employed on them; but I am convinced that the execution by famine labour of such a vast number of scattered works will be impracticable; and I feel sure that in any severe famine in this province recourse will have to be had to road work.

In this province there are 6,332 miles of roads, mostly gravelled, and it may be assumed that 5,000 miles are in the famine zone. If three feet depth of metal for 15 feet width were collected (which would be available for repairs for several years), it would mean 44 millions of cubic yards of metal; and if each coolie breaks ½ cubic yard per day, it would keep 88 million coolies employed for one day, or, in round figures, 500,000 coolies for six months.

There would besides be the collection of binding material and the spreading of first layer, watering and ramming.

Though I believe collecting and spreading metal to be the best form of relief works, there are other forms that I consider nearly as good. One of these is excavating channels, such as the channels (estimate about five lakhs for earthwork) from the Marikanave reservoir, and there will be other channels from the new reservoirs proposed for construction.

This kind of work requires more supervision than collecting metal, as levels have to be carefully kept; and the laying out and checking the work done and making payments involves a great deal of labour, and this leads to speculation.

Rail-roads.

I cannot understand why there should be any objection to the construction of rail-roads as famine works, as the earthwork to these certainly does not require so much care in its execution as in the case of large irrigation works.

I consider that the formation of railway cuttings and embankments, and collection of ballast, would be a very good form of relief work; always supposing that the surveys and estimates have been completed and the line selected.

In this province we have projects for two such lines ready—one from Bowringpet to Kolar and the other from Chikballapur to Dodballapur. Projects for the lines from Arsikere to Mangalore, and Mysore to Tellicherry, will shortly be ready. The formation of the cuttings and embankments and collection of ballast for such lines cannot cause any loss; for even if the rails are not laid for some years, the work done will not deteriorate; in fact will actually benefit by having been exposed to several monsoons, if small sums are spent annually on maintenance of banks and drainage of the cuttings. I therefore consider that collecting road-metal and earth-work, etc., to railways should form by far the largest item in the famine programme, and in addition as many large irrigation works as can be found should be entered, to be carried out under the ordinary rules of the Public Works Department. As regards village relief works, and small irrigation works, it will be sufficient if a list of such works were entered; to prepare estimates for each of these would be waste of time, as the conditions of the *bunds* may be quite different when famine occurs, and the estimates would be useless It would be better to prepare the estimates as necessity arises.

They would probably be only roughly prepared, but even admitting this fact, are more likely to be correct than if prepared years before.

As stated before, there are 1,013 major tanks in the province yet to be restored, and the estimates for these are now being prepared by the Executive Engineers for insertion in the famine programme. The probable average cost of restoring each tank will be about Rs. 5,000, so the total sum that can be expended in this way will approximately be 20 lakhs, and it would be very advantageous, in a famine protective sense, if such works could be carried out; but I believe it would be impracticable to properly supervise 1,013 works scattered over above 27,000 square miles, and if not properly supervised, the work done would be nearly useless and a large sum of money wasted. It would therefore be advisable to attempt to carry out only as many as could be properly supervised, which I do not think would be more than 80 at a time.

A special Superintending Engineer is now employed in preparing preliminary reports regarding new large irrigation works that can be of use as famine protective works whether they will prove directly remunerative or not. The estimates for these may amount to many lakhs of rupees. A storage work is considered remunerative if the cost of storing 1 unit, *i.e.*, 261,360 c. ft., is Rs. 100 or less. A unit of water is sufficient for one acre of cultivation on which the average assessment may be taken at Rs. 4.

In this province the rayats are bound to pay an acreage contribution towards the cost of the execution of any irrigation work by which they will benefit, costing over Rs. 25,000. The amount of contribution varies and by the rules no work should be begun till it has been paid.

In the case of works under Rs. 25,000 the contribution is voluntary. In times of famine it would probably be necessary to waive the claim for contribution.

As regards the 2nd subject before the Commission, viz., whether opportunities exist for utilizing minor channels, storage reservoirs, etc.—This is already answered by what I have written. There are about 10,000 minor tanks that can be usefully restored and repaired besides the feeder and distributary channels connected with them; the average cost of the work required to each would not exceed Rs. 500, or in all 50 lakhs, and no doubt by this expenditure a good deal more water could be restored.

On page 11 I have given the number of tanks in each district, and it will be seen that the Hassan, Kadur, and Shimoga districts are the best supplied with tanks; but most of these tanks are situated outside the famine zone, and are in most cases mere ponds or small *kattes* at the heads of perennial streams in the Malnad.

The Kolar district with its 5,497 tanks is, perhaps, the best provided with storage works, as it is calculated that 85 per cent. of the rainfall in average years is caught by these tanks; but nevertheless this year there was a near approach to a famine in the district. It is therefore evident that small reservoirs are no direct protection against famine, as, when there is deficient rainfall, they only receive a partial supply. They are of use indirectly, as, by irrigating the full area during a good year, they tend to mitigate the distress in a bad year.

The only real protection against famine are reservoirs that will hold a two or three years' supply for the lands under them and channels from the larger rivers which have their sources in the Western Ghats and Coorg.

Duty of water.

As the duty of water affects materially the area that can be irrigated, it is a matter that should be carefully considered. In this province the duty for direct irrigation is taken at 1 c. ft. per second for 25 to 30 acres, or sometimes less; that I believe to be far too low. but no experiments have

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been made, and the regulation is under the civil authorities.

In Madras the duty was formerly taken at 1 c. ft. for 66 acres; but from experiments made lately, it is found, I believe, that in the cases of large areas of cultivation 1 c. ft. is sufficient for 100 acres. The matter is one of great importance; for, if the duty of water can be doubled, that is, 1 c. ft. can suffice for 60 acres instead of 30, the irrigation from the Cauvery channel might be very much extended.

The duty of water should depend a good deal on the conditions of the irrigation, the rainfall, and the nature of the soil. In this province the land irrigated by channels is generally cut into terraces, and the soil is mostly red soil. Under tanks the *ayakat* is usually flatter than under channels, and the soil varies, being sometimes red and sandy and sometimes black cotton; but in all cases it is assumed that 261,360 c. ft. of water is sufficient for 1 acre of paddy.

There would no doubt at first be considerable difficulty in reducing the supply of water by half, as there would be great opposition on the part of the rayats, but I think it would be well to try the experiment on one channel, and if successful apply it to all.

In the case of storage works it is assumed in this province that 1 unit = 261,360 c. ft. is sufficient for 1 acre, including evaporation. The unit is calculated as 6 ft. depth on 1 acre.

If we take the evaporation to be 2 ft. during the six months of irrigation, the duty of water is 1 c. ft. per second for about 90 acres; and if no allowance is made for evaporation, about 1 c. ft. per second for 60 acres; this seems to prove that the duty of water in the case of direct irrigation is much too low.

Proposed famine protective works.

I have now received the statements of proposed famine protective works in the several districts and they are attached to this note. From them the following information is gathered:—

Kolar district.—In this district there are six works for which no detailed estimates have been prepared. The approximate cost of these works is Rs. 5.38,000, of which sum Rs. 2,00,000 would be available for famine labour. This at Rs. 8-8-0 per head per month would give employment to 12.333 persons for six months; that is to say, 1·89 per cent. of the population of 650,133 (10 per cent. added to Census of 1891) for six months. The quantity of water that will be stored is 3,750 units sufficient to irrigate 3,750 acres in ordinary years, but in seasons of drought there would be no irrigation from them. The total expenditure will be Rs. 5,38,000, and the revenue derived by Government Rs. 15,500, or 2·88 per cent.

By increasing the area of irrigation to a small extent during ordinary years, the proposed works would no doubt be of some use in mitigating famine in years of drought, but in such years they would be practically useless for irrigation purposes.

Kolar is the district best supplied with tanks, and is, all the same, very liable to drought. There have been several years in which famine has been imminent, and I believe in times of famine sufficient irrigation work on which to employ the distressed could not be found, and that recourse would have to be had to roads and railroads.

Bangalore district.—There are six works in this district, of which four have been fully investigated and the estimates prepared. The approximate cost of all the six works is Rs. 13,83,833, out of which Rs. 7,65,000 would be available for famine labour.

The population of the district is 883,283 (10 per cent. added to Census of 1891), or say 800,000 omitting that portion of the population of Bangalore town not likely to be in need of relief. Rs. 7,65,000 would give employment to 36,429 persons for six months at Rs. 3-8-0 per month per head, or to 4·5 of the population. The amount of water that will be stored by the proposed works is 13,850 units, which will suffice for 13,850 acres in years of ordinary rainfall, but in years of drought only four of the works will be of any use, and these four together will then be able to irrigate 3,170 acres.

The total cost of the works being Rs. 13,83,833 and the revenue derived by Government Rs. 57,750, the percentage is 4·2 on the expenditure. It will be seen that in this district also the proposed works will have little direct effect in seasons of drought.

Tumkur district.—There are ten works proposed in this district, three of which have been investigated and the estimates prepared, six for which rough estimates have been prepared, and one regarding which nothing has been done.

The total cost of the whole of the works will approximately be Rs. 24,62,500, of which Rs. 12,83,000 will be available for famine labour. This will give employment to about 5 per cent. of the population of 689,119 persons for six months at Rs. 3-8-0 per month per head. The quantity of water that will be stored in years of ordinary rainfall will be 22,851 units, sufficient for 22,851 acres; but in years of drought only four out of the ten works will be of any use, and these four together will irrigate 5,560 acres. The revenue derived from the works will be Rs. 1,01,200, giving a return of 4·1 per cent.

Of these works the reservoir on the Shimsha river will be a fine protective work, as it will irrigate 4,000 acres in season of drought; but it cannot be considered remunerative, as it will only give a return of 3·6 per cent.

Shimoga district.—There are only two taluks in this district liable to famine. These are the Channagiri and Honnalli taluks.

Only three large works are proposed: for one a detailed estimate has been prepared; for another a rough estimate has been got up; and for the third nothing has been done.

The total amount of the estimates is approximately Rs. 17,10,000 and the amount available for famine labour Rs. 8,70,000, which at Rs. 3-8-0 per month per head would give employment to about 42,000 persons for six months; that is to say, 27 per cent. of the population of the area liable to famine.

The revenue derived from the works will be Rs. 74,500, or 4·4 per cent.

About 22,700 units will be made available by the works and 22,700 acres will be cultivated. In years of drought 21,600 acres can be irrigated, as two of the works are fed by perennial streams.

In addition to the works mentioned, there is a magnificent site for a reservoir at a place called Lakvalli on the Bhadra river. This project was investigated years ago by the officers of the Kurnool Canal Company. No finer site for a dam could exist, but unfortunately its construction would be of little benefit to the lands in Mysore territory that it would command, as that portion of the province is not liable to famine and the population is very sparse; but as a means of regulating the supply of water in the Tungabhadra and Krishna rivers for the benefit of lands in Madras, it would be invaluable. The drainage basin is 776 square miles and the average rainfall 150 inches per annum, and taking the run-off at 60 per cent. (not too great an allowance for such a high rainfall and hilly country), the amount received into the reservoir would be 200 m. c. ft. per square mile. The total supply would therefore be 155.200 m. c. ft.

The site is rocky, in the middle of dense jungles, and very unhealthy. The dam would probably cost 100 lakhs of rupees, but the benefit to Madras irrigation to be derived by its construction would be enormous.

There is also an excellent site for a reservoir on the Tunga river at a place called Mudaba. The average rainfall is 150 inches per annum and drainage basin is 782 square miles. This also would not benefit Mysore lands, but would be of great advantage to the irrigation in Madras.

The two reservoirs together could probably be made to store 400,000 units, and the drainage basins being so immense and the rainfall so heavy, the reservoirs would fill more than once. The amount stored would suffice for 400,000 acres.

Chitaldrug district.—This is the district most liable to famine; yet in the year 1895 when there was famine in the adjacent districts (Bellary and Cuddapah) in the Madras Presidency there was only slight distress in Chitaldrug, but in the great famine in 1876-78 many thousands of people died.

The soil is a great part of black cotton, and dry crops are easily raised by means of *kattes*, and the people do not seem keen about wet cultivation. Seven large works are proposed as famine protective works. One of these, the Marikanave reservoir, is now in course of construction; another has been fully investigated; but nothing has been done regarding the other five; and the Madras Government have objected to the construction of three of them.

The amount of the estimates for all the works, omitting the Marikanave, is Rs. 8,44,450, and the amount available for famine labour is Rs. 4,70,000, or sufficient for the employment of 4·8 per cent. of the population of 465,360 for six months.

The works will store 8,000 units of water in ordinary years, capable of irrigating 8,000 acres and 1,500 acres in season of drought. The revenue to be derived will be Rs. 31,000, being 3·6 per cent. on the expenditure of Rs. 8,44,450.

The Marikanave reservoir and channels now under construction is estimated to cost 39 lakhs of rupees The crest of dam will be 142 feet above the bed of the Vedavati river, the escape being at 130 feet.

Its capacity, when full, will be about 116,000 units, capable of irrigating 116,000 acres, but it will only fill in very exceptional years; and in years of ordinary rainfall the water received will be about 30,000 units and in very bad years not more than 10,000 units can be expected. Though this grand work may not prove directly remunerative, it will be a great protection against famine in the taluks of Challakere and Hiriyur which comprise that portion of the district most liable to famine.

Kadur district.—The only parts of the district liable to famine are the whole of the Kadur and parts of the Chikmagalur and Tarikere taluks. Six large works are proposed, the estimates for three of which have been fully worked out, and for the other three preliminary investigations have been made.

The total approximate cost of the works will be Rs. 4,55,871, and the amount available for famine labour Rs. 1,30,000, which would afford employment to 3·2 per cent. of population (189,438) of the area liable to famine.

The quantity of water stored by the proposed works will be 4,930 units, capable of irrigating 4,930 acres in years of ordinary rainfall and 2,300 acres in years of drought.

The revenue to be derived from the works is Rs. 25,000, which will give a return of 5·5 per cent. on the expenditure of Rs. 45,587.

Hassan district.—The portions of the district not liable to famine are the Manjarabad and part of the Belur taluks; the population of the remaining portions is 365,998.

The part of this district liable to famine is studded with tanks, and there is little scope for new irrigation works.

Only two works are proposed, and neither of these has been investigated in detail. The approximate cost of the works is Rs. 1,05,000, of which Rs. 58,000 is available for famine, which at Rs. 3-8-0 per head will give employment to about ·7 per cent. of the population of the area liable to famine for six months.

The works are for direct irrigation from perennial stream, and they will irrigate 2,500 acres in years of ordinary rainfall and 1,750 acres in years of drought.

The amount of revenue that will be derived from their construction is Rs. 7,000, which represents a return of 6·6 per cent. on the expenditure.

Mysore district.—The portion of this district which is under direct irrigation from channels taken off from the Cauvery and its branches is not liable to famine. The taluks that suffer during seasons of drought are Chamarajnagar, Gundlupet, Nagamangala, Mandya, Krishnarajpete, and Malvalli. The area of these taluks is 2,691 square miles and the population 559,766. The above taluks are covered with tanks, but during seasons of low rainfall they receive but little water.

Nine works are proposed in this district, the estimate for one of which has been prepared in detail, for five preliminary levels have been taken, and for three nothing has been done. The approximate amount of all the estimates is Rs. 36,45,000, of which sum Rs. 23,40,000 is available for famine labour. This would give employment to 20·2 per cent. of the population of the area liable to famine for six months at Rs. 3-8-0 per head per month.

Of the proposed works, three are for the extension of channels for direct irrigation; but unless the duty of water can be increased it seems doubtful if the irrigation under channels can be extended. These extensions are calculated to irrigate 19,500 acres. The remaining six works are reservoirs. The amount of water stored will be 11,300 units, sufficient for 11,300 acres. In years of drought 20,450 acres can be irrigated by both channels and tanks together.

The total revenue to be derived from the works is Rs. 1,48,000, which is about 4 per cent. on the proposed expenditure.

Besides the works mentioned in the statement, there are many old rough-stone anicuts that should be replaced by water-tight ones, and this, in my opinion, should be done before any attempt is made to extend the channels.

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The cost of rebuilding the anicuts will probably amount to 10 lakhs, but will not be a suitable work for famine labour. There is a fine site for a large storage reservior on the Cauvery river at a place called Ramaswamy Kanave,* on the borders of Coorg, but the Government of Madras would probably object to its construction.

From these district statements the following results are obtained for the whole province:—

Number of proposed famine protective works—

Fully investigated	. . .	13
Partly do.	. . .	15
Not do.	. . .	20
	Total .	48

Approximate cost of all the proposed works is Rs. 1,07,44,654, say 107½ lakhs of rupees.

The amount available for famine labour is Rs. 40,70,000, which would afford employment to about 5·2 per cent. of the population of the area liable to famine for six months at Rs. 3-8-0 per head per month.

The revenue derived from the works will be Rs. 3,68,870, or 3·4 per cent. on the expenditure.

The total amount of water stored will be 87,381, and the area irrigated in years of ordinary rainfall 106,881 acres and in years of drought 56,330 acres, including direct irrigation. But unfortunately in years of drought the districts most liable to famine, *viz.*, Bangalore, Kolar, Tumkur, and Chitaldrug, will only have the area of irrigation increased by 10,230 acres, while in the district of Kolar there will be no irrigation at all.

I may here mention that the figures given in the statements are only rough approximations. There has been no time to get out accurate figures before the arrival of the Indian Irrigation Commission.

Famine programmes.

A special establishment will now be employed on working out all the projects in detail and they will then be entered in the famine programme; such as are shown to be remunerative can be carried out in ordinary years as funds are available, and those that will be a protection against famine, though not directly remunerative, will be left to be carried out in years of scarcity.

Special establishments are now employed under the Executive Engineer of each district in preparing estimates for the 1,013 major tanks now remaining to be restored, and these will also be entered in the famine programme; the average cost of each will be about Rs. 5,000, making a total of Rs. 50,65,000.

There are, besides, about 10,000 minor tanks on which an average of Rs. 500 might be usefully expended, or a total of Rs. 50,00,000.

There are about 17,000 villages in the province, area liable to famine, and two or three relief works for each village should be entered in the programme. The total amount in each village need not exceed Rs. 200, making a total of Rs. 34,00,000.

The minor tank and village relief works, though included in the programme, need not be estimated for in detail till occasion arises.

We will then have a famine programme containing—

	Rs.
48 large new works costing .	1,07,44,654
1,013 major tank restoration costing	50,65,000
10,000 minor tank restoration costing	50,00,000
Village relief works costing . .	34,00,000

This, of course, is ample to meet any famine that may occur, but it would be impossible to carry out all these works at a time; and it will be necessary to select only as many as can be properly supervised, which (unless the staff of the province is augmented by officers lent by other Governments) I don't think will be more than 8 large new works, approximate cost 17 lakhs—

	Rs.
80 major tank restoration . .	4,00,000
160 minor tank restoration . .	48,000
Village relief works, say . .	30,000
Total .	4,78,000

But I have already shown on page 15 that Rs. 117 lakhs of work must be provided in case of a severe famine, and

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*Since found to be impracticable, as the town of Fraserpet would be submerged.

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I am of opinion that, in addition to the works mentioned, it will be necessary to have recourse to collecting road-metal, which will not require much professional supervision.

The following is my opinion regarding famine protective works:—

Famine protection.

Direct irrigation from channels such as those taking off from the Cauvery and its tributaries are a sure protection against famine. They have never failed even in the years 1876-78.

Tanks fed by perennial streams are also a sure protection. Large storage reservoirs containing a two or three years' supply, or which by feeding a stream make the supply perennial, are a protection against famine; but unfortunately it is difficult to find sites for such works and the cost of them is generally prohibitive.

Small tanks in the maidan parts of this province where the rainfall is small are no direct protection against famine. The Kolar district is an example of this, for, in years of deficient rainfall, they receive practically no water and the crops under them fail. They are an indirect protection, as, by producing a good crop during years of good rainfall, they would enable the rayats to tide over one or two bad years, that is, if they are provident.

Wells are an excellent protection against famine in a small way, but in years of excessive drought they generally run dry or nearly so.

In this province each well irrigates about 1·8 acres on an average, so the number of wells required to irrigate any large area would be enormous; still I think every endeavour should be made to induce the rayats to sink wells, as it no doubt affords a protection against famine in small areas.

My opinion is that so long as such a vast proportion of the population of India depends on agriculture, that is, on the rainfall, there must be periodical famines in places and no amount of irrigation works will prevent this, as these works are dependent on the rainfall.

The only means of preventing or at any rate of mitigating famine is to encourage industries and manufactures in as many parts of the country as possible.

The Kolar Gold Fields give employment to about 40,000 persons, and there is absolutely no chance of a famine there, though all the crops in the district should fail.

Answers to printed questions for Public Works officers.

1. *Population, area, etc.*

Statement of total area cropped, 1899-1900.

District.	Population, 1891.	Cultivable area.	Area cropped, 1899-1900.	Percentage of cropped to cultivable area.
		Acres.	Acres.	
Bangalore . .	802,994	1,098,880	651,323	59·2
Tumkur . .	580,786	1,632,000	973,691	59·6
Kolar . .	591,030	867,840	479,412	55·2
Mysore . .	1,181,814	2,023,040	1,407,256	69·5
Hassan . .	514,952	1,000,960	717,151	71·6
Shimoga . .	527,981	989,440	635,452	64·2
Kadur . .	330,063	673,920	491,230	72·9
Chitaldrug . .	413,984	1,594,240	1,148,047	72·1
Whole province .	4,943,604	9,880,320	6,503,562*	65·5

* There is a discrepancy of six acres between this and the total given for the whole province in the Mysore Atlas of 1900.

The total area cultivated in 1899-1900 is divided as follows:—

Dry, acres.	Wet, acres.	Gardens, acres.	Coffee, cinchona, cardamoms.	Total.
5,317,508	773,677	243,611	168,760	6,503,556

The following is the proportion of each of the above crops to the cultivable area:—

Dry	53·8
Wet	7·8
Gardens	2·4
Coffee, cinchona, cardamoms . .	1·7
	About 65·5 per cent.

The proportion between the cultivable area and the population is 1 person for 1·1 acre for the whole province, and 1 person for every 2 acres of the entire province, both cultivable and uncultivable.

Statement showing the average area of land irrigated for the last ten years, 1890—1900.

District.	EXTENT OF LAND IRRIGATED, AVERAGE, 1890—1900. ACRES. River channels.	Tanks.	Other sources, wells, and springs.	Total wet cultivation.
Bangalore . .	19	43,452	4,737	48,208
Tumkur .	937	52,906	7,681	61,524
Kolar . . .	1,428	49,964	2,288	53,680
Mysore . .	61,253*	32,632	6,131	100,016
Hassan . .	9,947*	72,956	20,475	103,378
Shimoga . .	3,111	105,649	108,167	216,927
Kadur . . .	5,445	33,206	65,483	104,134
Chitaldrug . .	2,190	21,769	1,205	25,164
Whole province	84,330	412,534	216,167	713,031

* These figures do not agree with those given under Cauvery channels; the reason being that the area under tanks fed by the channels is entered under tanks.

These figures are compiled from the Mysore Atlas of 1900. The total 713,031 acres does not quite agree with the average area of wet cultivation for ten years for the whole province, which is given at 748,068 acres. The difference can probably be accounted for by mulberry and sugarcane not being included in the former figures.

Statement showing the proportion of wet cultivation to cultivable area.

District.	PROPORTION OF WET CULTIVATION TO CULTIVABLE AREA. River channels.	Tanks.	Other sources.
Bangalore	·0017	3·9	·43
Tumkur	·05	3·2	·4
Kolar	·14	5·7	·26
Mysore	·3	1·6	·3
Hassan	·99	7·2	·2
Shimoga . . .	·31	10·6	10·9
Kadur	·81	4·7	9·4
Chitaldrug	·13	1·3	·07

Colonel D. McN. Campbell.

There have been no seasons of drought since 1876-77. The following table gives the area of wet cultivation in a year of bad and good rainfall respectively in each of the maidan districts of the province:—

District.	Average rainfall, 30 years.	Bad year.			Good year.		
		Year.	Rainfall.	Area of wet cultivation.	Year.	Rainfall.	Area of wet cultivation.
				Acres.			Acres.
Bangalore	29·86	1891	18·41	42,034	1893	41·13	50,074
Kolar	27 58	1891	16·16	42,916	1893	29·8	54,510
Tumkur	25·98	1891	16·5	51,935	1893	33·04	63,316
Mysore	27·22	1891	17·7	95,109	1893	33·78	96,726
Chitaldrug	20·76	1891	14·06	23,274	1893	29·04	24,566
Total	...	...	...	255,268	...	...	289,192

It will be seen from this that the difference between the area of wet cultivation in a bad and good year is only 33,924 acres in the whole province.

I am sorry I can give no information about private or village irrigation works.

2. *Soils.*

The prevailing soil in the province is red loam formed by the decomposition of gneiss and trap. Black cotton soil is found here and there, chiefly in the Kadur, Shimoga, and Chitaldrug districts. The red soil is generally very fertile, and is well adapted to irrigation. The black cotton soil is more suited to dry crops, but can be irrigated with advantage. As far as I know, no difference is made in the quantity of water supplied to cultivation on different kinds of soil.

3. *Black cotton soil.*

There are many small tank *bunds* in this province, constructed of black cotton soil, that do not leak. I have myself constructed a *bund* of black cotton soil to hold 30 feet depth of water, with no masonry core-wall, but with a puddle-wall in the centre. This has stood for 20 years. The large Kukasandra tank in the Kadur district has a *bund* of black cotton soil, but the front under the revetment is made with several feet in thickness of good soil. Black cotton soil dries and cracks badly in the hot weather, and a *bund* made of it is likely to leak and perhaps breach if it has not been soaked with rains; but in the case of tanks, which cannot fill unless there has been rains, the *bund* is nearly always saturated. In the case of channels it is different, and I have known water let into one when the banks of black cotton soil were dry, and the result was excessive leakage and several breaches. The remainder of this question can best be answered by the Revenue Officers, as they have the distribution of the water.

4. *State irrigation works.*

This can be seen in a bulky statement prepared in the office of the Examiner, Public Works Accounts.

The expenditure from 1881 to 1900 is Rs. 1,98,03,000.

The total area irrigated in a good and bad year has been given in my answer to question No. 1.

The total revenue derived from all sources of irrigation, except wells and springs, is Rs. 27,38,933 for 1899-1900.

The average annual cost of repairs to the channels under the Public Works Department is Rs. 70,000 and the cost of establishment Rs. 1,200 per mensem, or Rs. 14,400 per annum.

The average cost of the establishment employed on tanks is Rs. 18,000 per annum.

The average annual amount expended by the Deputy Commissioners on masonry works to tanks is Rs. 25,000; the earth-work is done at the cost of the rayats.

The total yearly cost of the up-keep of irrigation works is therefore—

	Rs.
Channel repairs	70,000
Establishment	14,400
Tank repairs	25,000
Tank establishment	18,000
Total	1,27,400

This does not include cost of direction and accounts.

Deducting Rs. 1,27,400 from the gross revenue of Rs. 27,38,933, the net revenue is Rs. 26,11,533, which is about 13 per cent. on the capital expenditure since 1881. But this large percentage is no doubt due to the expenditure incurred prior to 1881, and I do not see how it is possible to ascertain the capital cost of all the irrigation works in the province.

The expenditure on irrigation works from 1799 to 1900 (omitting that for the years 1810—1831, which is not known) is Rs. 2,56,54,177, and the present net revenue would give a return of about 10 per cent.

The works are not to be depended on in seasons of drought, with the exception of the Cauvery channels and tanks fed by perennial streams in the Malnad tracts of the province.

5. This is fully answered in my memorandum, dated 20th December 1901.

6. I cannot answer this question; it is a matter for the Revenue Department.

7. Most of this question is answered in my memorandum, dated 20th December 1901.

The distribution of water is under the Revenue authorities, except under the Cauvery channels during the dry season; so details regarding number of watering, etc., can best be obtained from the Revenue Officers.

8. I have referred this to the Superintending Engineers, and when the information is received, I will attach it to this memorandum.

9. No flood or drainage protective works are required in this province.

10. There has been no famine since 1876-77.

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1. *Q.* (*The President.*)—You have long experience of Southern India?—Yes; 33 years.

2. *Q.* You were Chief Engineer for Irrigation in Madras?—I was Chief Engineer of the Public Works Department.

3. *Q.* Were you employed on different irrigation works?—Yes.

4. *Q.* You have been some years in Mysore?—Yes; 3½ years; I was there two years before.

5. *Q.* You give us a very interesting paper. I see in the second page of your note you give five series containing 1,717 tanks, of which 906 have been dealt with?—Yes.

6. *Q.* In Chitaldrug 105 out of 110 have been dealt with; practically this district is finished?—Yes; the series shown in my note are only typical.

7. *Q.* How many series are there altogether?—50.

8. *Q.* You give this list of the largest and most important tanks; are they separate from the series?—They are in the series.

9. *Q.* You say "the capacity of a unit." What is a unit?—It is ·26 of a million cubic feet. A unit is supposed to irrigate one acre.

10. *Q.* That allows a depth of 6 feet on an acre?—Yes.

Colonel D. McN. Campbell.

11. *Q.* Do you find that useful to go by?—Yes, very useful.

12. *Q.* It is pretty accurate?—Yes.

13. *Q.* Have you arrived at a satisfactory system of keeping tanks in repair?—No.

14. *Q.* Do you see your way?—No. The rayats may be made to keep them in repair; otherwise I don't see how it could be done.

15. *Q.* Do you think Sankey's scheme was a feasible one to carry out?—That was for extraordinary repair; the rayats were supposed to keep them in repair.

16. *Q.* Do you find that they will not afterwards keep the tanks in repair?—Sometimes they do; as a rule they don't.

17. *Q.* Do you see any practicable way out of the difficulty?—Government could not possibly keep the remaining tanks in repair; it would be impossible.

18. *Q.* Is there any sort of District Board system in Mysore?—Yes.

19. *Q.* They do not look to the tanks?—No.

20. *Q.* It does not come within their jurisdiction?—No.

21. *Q.* You say in the third page "the table of discharges of rivers in Mysore is fairly reliable"?—I think so.

22. *Q.* You say "you use about 20 per cent. of the amount of water ordinarily available for irrigation"?—Yes.

23. *Q.* In some cases you practically use it all up?—Yes.

24. *Q.* As regards *kudi-maramat*, do you find the rayats pay more attention to the channels than to tanks?—No.

25. *Q.* We were told the other day that rayats would not repair the *bunds*, but would still keep their channels clear of silt?—When they find actually that they cannot get water, then they clear them.

26. *Q.* You speak of masonry anicuts; what channels do you refer to?—The Cauvery channels; they are the only ones that the Public Works Department have got anything to do with.

27. *Q.* The reason being that the Cauvery has a very fair discharge?—Yes.

28. *Q.* Talking about the establishment on the channels, you say that "the monegars are under the Public Works Department during the dry season"?—That refers to the regulation of water during the dry season.

29. *Q.* Is there any water during the dry season?—Yes.

30. *Q.* What is exactly the position of Public Works Department officers. Do they merely keep the channels in repair?—Yes, and they regulate the supply of water during dry months. From the time irrigation is over when the cultivation is over we take over the channels, repair them and regulate the supply of water.

31. *Q.* There is a kind of system of "tatils" on the channel?—Yes.

32. *Q.* You speak of the rules drawn up by the Governments of Mysore and Madras. The thirteen rivers referred to run into Madras?—Yes.

33. *Q.* That means that you must not block the supply?—Yes.

34. *Q.* That there might be no interference with the working of the anicuts below. Do you find difficulty in getting leave to carry out new works on these rivers?—I have not asked permission.

35 *Q.* Do you anticipate that there might be difficulties in carrying out other desirable projects in Mysore?—I think so; if we wanted to secure flood water and make a reservoir, we would have to obtain the permission of the Madras Government. I don't know whether they would grant it or not.

36. *Q.* Have you personally, since you came to Mysore, or before, given much attention to the subject of the storage of upper waters of the Tungabhadra in the north of Mysore?—I don't know a great deal about it. There are plenty of sites on the Tungabhadra for large reservoirs.

37. *Q.* In Mysore?—Yes.

38. *Q.* They would not benefit Mysore?—They might, but it is most difficult to make a channel.

39. *Q.* Could an arrangement be made between the Mysore and British Governments to make a reservoir and to take up land from Mysore?—I think so.

40. *Q.* You are quite sure about this?—Yes.

41. *Q.* You only repair tanks which yield over Rs. 300 a year?—Yes; I am sure it would not be advisable for Government to repair the smaller ones.

42. *Q.* Are there many cases in this province where there are tanks, the water of which is not fully used?—Yes. There is the Sulikere tank.

43. *Q.* Do you know what the circumstances are?—What prevents it from being used?—I do not know; the tank never fails.

44. *Q.* There is plenty of water?—Yes.

45. *Q.* You don't know whether this is a case of black cotton soil?—I don't know.

46. *Q.* Supposing this country were unhappily to be visited by drought again, as it was 24 years ago, do you think it is substantially in a better position to meet it?—I think so.

47. *Q* What are your reasons?—Railways; and there is more irrigation under river channels.

48. *Q.* Much more?—A good deal more.

49. *Q.* I see you point out that the tanks in Kolar are no direct protection against famine?—Because the tanks are small and do not fill; they have but little water, or are altogether empty.

50. *Q.* If there is no possibility of extending tank irrigation in Kolar, would it be a good thing to encourage wells?—Yes, to a certain extent.

51. *Q.* Do you believe that very much could be done by wells?—Could they be extended; could they be increased in number practically without limit?—I don't think so; no; a large well in this province irrigates about 1·3 acres; they are only useful for small areas.

52. *Q.* When do you expect to get your Mari Kanave work finished?—In another two and-a-half years.

53. *Q.* It is a masonry dam?—Yes.

54. *Q.* (*Mr. Muir-Mackenzie.*)—Will it always fill full?—It will very seldom fill; we will be able to cultivate in ordinary years 30,000 acres.

55. *Q.* Would you refuse to give water for land under the tank, because you want to retain it for next year? Would you limit the area?—No; it would be of no use, because water would evaporate before next year. When the tank is half full one can only cultivate half the area.

56. *Q.* You suggest that the rayats should cultivate according to the quantity of water in the tank?—Yes.

57. *Q.* Then a man with influence would take the whole water? Don't you think that he would take as much water as he could get?—Yes.

58. *Q.* (*Mr. Higham.*)—The figures given here show expenditure on irrigation works. Is that capital expenditure?—Yes.

59. *Q.* Do you keep a regular capital account separately?—This is an account of the amounts spent on the construction of these works.

60. *Q.* Are capital and revenue accounts kept separately?—We don't keep regular capital and revenue accounts.

61. *Q.* They really are works for which revenue accounts are kept?—Yes.

62. *Q.* Have you many new tanks? How do you charge them?—To revenue.

63. *Q.* Could you say what return on the capital cost your works yield?—No.

64. *Q.* All that you say is that "during so many years we spent forty-one lakhs and the revenue has been so and so"?—Yes.

65. *Q.* That expenditure includes not only the construction and reconstruction, but also all ordinary expenses of working?—Yes.

66. *Q.* You say "the assessment on areas irrigated by tanks is about Rs. 6·3 per acre"?—Is that total assessment?—It is the total assessment.

67. *Q.* Why do you exclude mulberry and sugarcane from wet lands?—They are sometimes classed as garden and sometimes wet in revenue accounts.

68. *Q.* Wet lands do not include garden?—No.

69. *Q.* Garden cultivation includes all high class crops?—Plantains, sugarcane, and karry.

70. *Q.* In your calculation of the amount of work you require in the case of famine you proceed on the basis that each person will earn generally Rs. 3-8-0 a month?—Yes.

71. *Q.* Do you take the value of the work to be done by multiplying the number of people to be employed by the quantity of work to be done?—Yes.

72. *Q.* Do you assume that you will get full value of work in famine labour?—No.

73. *Q.* If they do only half the estimated value of work, you would employ double the number of people?—Yes.

74. *Q.* In that calculation you proceed on the supposition that every person's average pay is Rs. 3-8-0, and that you get Rs. 3-8-0 worth of work out of him?—No; we don't get that amount of work out of him.

75. *Q.* Out of the Rs. 3-8-0 you pay him, Rs. 2-0-0 would be the value of work he does and Rs. 1-8-0 would be extra gratuitous relief?—Yes.

76. *Q.* Supposing he does half a day's work, you will employ twice the number of men?—Yes.

77. *Q.* In regard to famine relief and irrigation works, you say irrigation works must be kept and proceeded with without reference to famine labour; when famine comes you would have a certain number of large works in progress which would give employment to a certain section of the population; you will have small irrigation works which the Public Works Department officers will look after and you will have village works that the Civil officers will look after; and you would have road-metalling?—We should have as many irrigation works as we can superintend and then road metalling.

78. *Q.* You would proceed with such works as you have in progress to the full extent?—Yes.

79. *Q.* You would not keep any in reserve for famine relief?—No.

80. *Q.* You would take them all up in the ordinary course? —Yes.

81. *Q.* In famine times you would treat the large works in the ordinary way?—As much as possible.

82. *Q.* You would not put people on task work?—If there is enough provision I would.

83. *Q.* You say "storage works, the cost of which is Rs. 100 or less per unit, are remunerative." Does that include the mere cost of storage or total expenditure?—Everything.

84. *Q.* That is a sort of standard you have?—Yes; there are very few exceeding Rs. 150.

85. *Q.* How much will a unit irrigate?—An acre on which the assessment is Rs. 4.

86. *Q.* Rs. 4 would pay interest?—Yes; it would give 4 per cent.

87. *Q.* It would not pay the upkeep?—No.

88. *Q.* It is quite good enough if it pays its working expenses?—Yes.

89. *Q.* (*Mr. Ibbetson.*)—You state at the end of your memorandum that expenditure on proposed irrigation works will be 1,072 lakhs; that, of course, means that you take the capital cost on very large irrigation works?—Yes.

90. *Q.* At page 3 (*d*) of your replies to questions you give us the expenditure during the last ten years on works which cost Rs. 25,000 and upwards in the three districts of Tumkur, Chitaldrug, and Kolar; you have spent, it appears, in Tumkur seven lakhs of rupees wholly on restoration?—Yes.

91. *Q.* So that this expenditure in Tumkur should not, strictly speaking, be debited to capital cost?—No.

92. *Q.* Taking it as capital expenditure it works out to 1·4 per cent.?—Is it not an extraordinary difference, as compared with the figures in your written evidence?—Yes; I put the total expenditure in the whole province; that includes the Cauvery channels and everything.

93. *Q.* Leaving that point you tell us that you have storage tanks irrigating some 4,000 acres and that you expect to get 3,000 new acres cultivated?—Yes.

94. *Q.* According to these figures you nearly double the irrigating capacity of these tanks. Do you usually expect such results from your scheme of restoring tanks?—Yes; we repair the whole tank and raise the weir; sometimes 5, 6, 7, or 8 feet.

95. *Q.* You expect to something like double the irrigated area?—Yes.

96. *Q.* You point out that if you did not restore the tanks, you would lose the revenue on 4,000 acres?—Yes.

97. *Q.* Your restoration brings in only something like 1·4 per cent.?—Actual restoration.

98. *Q.* It is not a paying business?—No.

99. *Q.* In the Kolar district you give three new works. They were finished three or four years ago and they pay one per cent., half per cent., and 9 per cent.?—Yes; we had bad years since they were constructed; I don't know about the tanks; they cost about Rs. 150 per acre.

100. *Q.* Have you any older tanks in Mysore of which the capital cost is known?—There must be some.

101. *Q.* You don't know which they are?—No.

102. *Q.* Do you know whether anyone could give us these figures?—No.

103. *Q.* (*Mr. Rajaratna Mudaliar.*)—In your memorandum you say, referring to the rule passed in October, 1873, that the rayats should maintain their tanks. Do you know if that rule is in force?—Yes.

104. *Q.* If it has been in force, what is the difficulty in keeping the minor tanks in order?—Because it is not always enforced; it is enforced sometimes; but, as a rule, the *bunds* are allowed to get lower and lower till there is a breach.

105. *Q.* If the rule were enforced, there would be no difficulty in keeping the tanks in order?—No, if it could be enforced.

106. *Q.* Do you think that the rayats would be induced to keep the tanks in order if remissions were granted in seasons when the crops failed owing to the failure of water-supply?—I don't think it would have any effect.

107. *Q.* If remissions were granted when there was a failure of supply, but refused if this duty was not carried out?—I don't think so.

108. *Q.* Supposing a certain percentage of assessment is remitted subject to the condition that the tanks would be kept in order, would they be induced to do the necessary repairs?—How are you going to make them keep the tanks in order.

109. *Q.* It would be something like the old *dasabandam* remission. Under that system persons who kept their tanks in order were granted certain remissions of revenue; if that duty was not performed, the remission was withheld?—I don't think it would have any effect; they know if they don't do it, it will be done by Government.

110. *Q.* Supposing 20 per cent. were remitted from the assessment?—I don't think it would be any good.

111. *Q.* Even that will be no inducement?—No.

112. *Q.* On page 20 you refer to some sites in the Mysore territory which were selected for the Tungabhadra reservoir; do you think that any large area will be submerged?—A good deal; forest reserves will be submerged.

113. *Q.* There would not be loss of revenue to the Mysore Government?—I don't know; I have not seen the sites myself; but I think that on those sites a greater portion of the area would be forests and jungles.

114. *Q.* (*Mr. Nicholson.*)—Are these tanks in Mysore chiefly in chains?—Yes.

115. *Q.* That being so, is it possible generally to raise the *bunds* and weirs of tanks without causing either loss of water to the tanks below or submerging the land above?—It must submerge the land above.

116. *Q.* How? Submerge the cultivated land above?—Yes.

117. *Q.* Benefit to one land is often carried out by the loss of land to the tank above?—Generally there is dry cultivation; the cultivation from the tank above does not come down to the waterspread of the lower tank.

118. *Q.* Are you not met with the objection that by enlarging a tank you cut off the water-supply of the tank below?—We always calculate how much water is available.

119. *Q.* You were asked what were the basis of the statistics as to the value of all cultivated crops on page 14; it is from official records?—Yes.

Mr. P. Roscoe-Allen.

MR. P. ROSCOE-ALLEN, M.I.C.E., Chief Engineer for Irrigation, His Highness the Nizam's Public Works Department.

(*Hyderabad, 21st February 1902.*)

1. *Q.* (*The President.*)—We wish to get some information as to the present state of protection by irrigation in His Highness the Nizam's dominions and as to what proposals are under consideration for increasing the protection of the country against famine?—On page 10 of my memorandum* I have given a statement showing the area under cultivation in the Telingana districts, and on page 2 I have given a similar statement relating to the Mahrattwara districts.

2. *Q.* Are the tanks, in the dominions, out of repair?—Yes; all, excepting those few which have been lately repaired.

3. *Q.* By "out of repair" you do not mean silted up?—No. I mean breached or otherwise in an inefficient state. In the dominions we shall never suffer much from tank silting up, as the conformation of the land is such that we can readily raise the *bund* and so increase the capacity of the tank as the silt accumulates in its bed.

4. *Q.* How long have you been here?—For the last four years.

5. *Q.* The last famine was very bad in the Nizam's dominions?—Yes; the famine of 1309 F. was the worst on record.

6. *Q.* Was it very bad in Telingana?—The state of actual famine was never reached in Telingana, although distress was severe. We happened to have an enormous number of estimates for works really which Mr. Dunlop, the Famine Commissioner, gave us leave to put in hand, and so the necessity of opening famine works on code rules was averted. Late in the season three test works had to be opened in the Elgandal district in talukas where our programme of work was a little deficient compared with other talukas.

7. *Q.* You are better able to withstand famine now than you were a few years ago?—Yes; as regards the Telingana districts, we have better storage works and a larger programme of work.

8. *Q.* I notice that some of these tanks depend on catchment areas which can be counted on in case of a failure of the rains?—Yes, especially in the Warangal district there are certain tanks which can be depended on to ensure some cultivation even in the driest years. In most districts in Telingana this will be the case if the schemes I have designed for connecting tanks with the larger local rivers are carried out.

9. *Q.* Have these schemes progressed far?—We have not completed many schemes as yet, but we have a large number in hand and good progress is being made.

10. *Q.* Have you any map showing all the tanks in your charge?—The 4 miles to an inch Ordnance Sheets show practically all the tanks; only one or two tanks are omitted. Where a tank is breached, it is marked on the map by a line. You see from the map that immediately you get south there are fewer tanks. The system of tanks in Telingana, where there is red soil, is most perfect. The formation of the Carnatic districts is not so suitable for tanks, and the soil is not so favourable for wet cultivation.

11. *Q.* What measures do you propose for these south-west talukas of the Carnatic districts?—I have proposed to execute the Benur channel project from the Tungabhadra river; the Muski storage project is also under consideration. For the rest it is proposed to restore such old tanks as it is considered worth while and execute any new storage scheme which is at all likely to give a good supply in years when the rainfall is deficient.

12. *Q.* What are the Gungawati channels?—They are two channels originating in the Tungabhadra in the Gungawati taluka of the Lingsugur district and are working most satisfactorily. The lands under them gave a full revenue during the last famine.

13. *Q.* What is the area irrigated?—The area irrigated in 1309 F. was 3,130 acres.

14. *Q.* Is it in the valley of the Tungabhadra?—Yes.

15. *Q.* Is any extension of these channels possible?—I do not think it will be feasible to extend the existing channels much; but if the channels are improved, the cultivation under them can be extended. The water in the channels at present does not do its proper duty; it only irrigates some 30 acres per cubic foot per second of discharge. We have, however, raised the revenue under these channels from Rs. 36,000 to Rs. 46,000 since the Public Works Department took charge of them. The maintenance and distribution of the water is now entirely in the hands of the Public Works Department.

16. *Q.* (*Mr. Rajaratna Mudaliar.*)—How much has the *ayakat* under those channels increased?—I do not know exactly; the area has increased more in proportion than the revenue, because the Revenue Department have been lowering the rates. Double-crop rates were reduced from 1½ to 1¼ times single rates, but I understand that this will again be altered. There were 1,100 acres of sugarcane under these channels in 1309 F.

17. *Q.* (*The President.*)—What is the Moosapett project?—It is a tank-filling project situated in the Mahbubnagar district. A channel is taken from a local river, an affluent of the Kistna, to fill a large number of tanks. The river runs only during the rainy season, and so we can only make use of flood water in this project; after the rains the river rapidly dries up.

18. *Q.* How much land will the Kistna project command?—The District Engineer reports it will command 200,000 acres in the Raichur Doab (the country between the Kistna and Bhima rivers).

19. *Q.* Is there any other project for storage on the Kistna?—There is no project from the Kistna. In its course through the dominions the Kistna runs in a very deep bed and is very rapid. Where it passes through the Nallamallai hills the gorge is very deep and the current is rapid. The channel from Narainpur (the Kistna project) is the only feasible project we have.

20. *Q.* Is it of the same character when it joins the Tungabhadra?—Yes, and the current is so swift that it carries sand in suspension. In the dominions we have to exercise considerable care in the site we choose for the off-take of a channel from a river; if the off-take is situated where the fall of the river is great and the current strong, the result is much sand held in suspension in the water entering the channel; this is either deposited in the channel or on the rayat's fields, and is, in either case, a nuisance. When deposited in the rayat's fields the outturn of the crop is lessened and the rayat, ignorant of the true cause, says "that the water is not good for irrigation."

21. *Q.* (*Mr. Rajaratna Mudaliar.*)—Is that why the people prefer what they call "black water" to "red water"?—Yes; the black water contains fertilizing silt and the "red water" contains sand.

22. *Q.* If the Kistna carries sand, it will *à fortiori* carry silt?—Yes; such is precisely the case also with the Godavari. The late Sir Vikar-ul-Oomra repaired an old anicut across the Godavari to supply water to lands in his *jagir* in Elgadah. I was asked to report on this some time ago. I found the anicut situated half-way down a cataract in the Godavari where, of course, much sand was held in suspension by the water of the river; the fall of the channel was also great, and all this resulted in much sand being deposited on the rayat's fields and their usual complaint about the water. This channel passes through several tanks, and below the first tank, where evidently the sand in suspension is dropped, the complaints ceased.

23. *Q.* Have you any other big projects?—We are now enquiring into one from the Godavari.

24. *Q.* That means a dam over the river; would that be easy?—Yes, the easiest thing possible. The site of the proposed dam is at the top of a rapid and the bed of the river here is sheet rock.

25. *Q.* You are now in the preliminary stage?—Yes. Like other projects we propose, if the preliminary stages point to the likelihood of success, executing the project by sections. In the dominions we have no proper idea of the discharge of the rivers at different seasons of the year, as no observations have, as yet, been made. The only river, of which we have any knowledge, is the Moosi. Our projects are thus, as far as possible, designed to be carried out in sections; a second section is carried out if the supply of water proves adequate. Meanwhile, all masonry works which in any way confine the width or discharge of the channel are, in the first instance, made large enough to carry the supply which will be ultimately required.

26. *Q.* Are you now taking gauges of the rivers?—We have now commenced to do so.

27. *Q.* How many tanks have you got in good working order?—I should say about 1,000 major tanks. I cannot say how many minor ones.

28. *Q.* You gave on page 3 of your memorandum a list of tanks which held water during the last famine?—Those

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* Not printed.

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are only a few typical cases. With regard to the Avanur tanks, the printed figures are wrong. The "free" catchment area should be 1¾ square miles and the "combines" should be 4 square miles.

29. *Q.* Which of the tanks are in good order?—Certainly not half of them. More than half of them may be yielding some revenue, but they are certainly not in an efficient state.

30. *Q.* What is the exact area under wet cultivation?—We can only ascertain that by finding out the amount of remissions that have been given and deducting this amount from the gross revenue. The remissions are very large at present owing to the large number of tanks which are in disorder. I have not the figures of the remissions with me. The remissions during late years have been very large.

31. *Q.* You have a table on page 10 of your memorandum showing wet cultivation in the Telingana districts. Does that include wells?—Yes.

32. *Q.* As to tank repairs, will you be so good as to tell us how they are kept up?—As far as the major works are concerned, we propose to put the maintenance in the hands of the Public Works Department. I think this will be necessary, as the nature of the work necessitates a trained staff being in charge. In the case of tanks, they are given certain definite minimum dimensions such as height of *bund* above maximum water level, breadth of *bund*, length of escape-way, etc. It is absolutely necessary that they should be kept up to these dimensions. Again, the length of escape-way is calculated on the same empirical formula in all cases and it is at the best approximate. Information is required directly it is ascertained that the allowance made for the disposal of surplus water is insufficient. The case of channels is precisely the same and, in addition, a trained staff is further required to manipulate all scouring sluices in channels and so obviate the nuisance from the accumulation of silt in the bed. To execute all this work efficiently, it is necessary that the maintenance should be in the hands of a trained staff under the orders of the Public Works Department. Other than this there is the necessity of collecting data for guidance in future designs and which can only be done by a trained staff. I have found from experience that when the maintenance is in the hands of the Revenue authorities irrigation works rapidly get into disorder. Especially is this the case when channels are concerned. The channels under the Revenue authorities rapidly blossom out into *pikotas* and unlicensed sluices; below each of these a *bund* is thrown across the channel and very soon the channel becomes in a most inefficient state. Revenue officers have often explained to me that if such things are allowed more revenue accrues, but such is not the case, as it is done to the detriment of existing revenue. Again, when clearing a channel of silt, Revenue officers never know what width the bed should be cleared to in its various sections. I am decidedly of the opinion that the maintenance of all minor works should be in the hands of the village community, or some one interested in the cultivation under it, under the supervision of the Public Works Department.

33. *Q.* Is there any institution here like the ***kudi-maramat*** in Madras?—There used to be, but it has fallen into disuse.

34. *Q.* You say that estimates, amounting to Rs. 64,68,987 for 538 works, have now been sanctioned by your Government. That ought to keep you going for a long time?—The vast majority of these works are already in hand. These estimates refer to major works in the Telingana districts only.

35. *Q.* What are you spending now? How much do you propose to spend each year?—I have advised the Government to spend 25 lakhs a year on irrigation works. Last year we spent some 17 lakhs. We have been gradually working up the expenditure. When I came here the expenditure was only 5 lakhs, and I have now worked it up to 17 lakhs which includes expenditure under the "New Scheme."

36. *Q.* (***Mr. Muir-Mackenzie.***)—The "New Scheme" expenditure being 5 lakhs?—Yes, about 5 lakhs.

37. *Q.* And you propose that the Nizam's Government should give 20 lakhs a year?—I propose that 15 lakhs should be given from the revenue; 5 lakhs should be raised by loans; and 5 lakhs be expended under the "New Scheme." That is my proposal, but it is not as yet sanctioned.

38. *Q.* (***Mr. Higham.***)—In the Mahrattwara districts you have practically no tanks at all?—Very few indeed, and those are mostly situated in Nander on the borders of the trapean plateau.

39. *Q.* You have irrigation channels from the Tungabhadra?—Yes.

40. *Q.* There is a good deal of well cultivation?—Yes; I have given the figures in my memorandum.

41. *Q.* You have only river channels in Lingsugur?—Yes, and a few tanks, which latter are in disorder.

42. *Q.* I understand that most of the wet cultivation in the Mahrattwara districts is under wells?—I am not well acquainted with the Mahrattwara districts, but I believe such is the case; Mr. Dunlop will, however, inform you on this point.

43. *Q.* What does the area irrigated by river channels amount to?—About 4,000 acres.

44. *Q.* And what under tanks?—That I cannot tell you. We have a few tanks, but the total area under tanks is not great.

45. *Q.* You know enough about the Mahrattwara districts to state that the area under tanks cannot be large?—I know sufficient to state that it cannot be large.

46. *Q.* So that the irrigation must be mainly from wells?—I believe it is mainly from wells.

47. *Q.* Referring to the three Carnatic districts, you say—"Of the estimates prepared by the staff, estimates amounting to Rs. 10,53,488 for 39 works have been sanctioned by Government; estimates amounting to Rs. 19,100 for four works are awaiting sanction; and estimates amounting to Rs. 7,56,959 for five works are awaiting the approval of the Chief Engineer." What works are these?—The Benur project, estimate Rs. 8,14,000, is one of the sanctioned estimates; and there are 38 smaller works mostly tanks, of which the Sirwall tank costing Rs. 41,000 is the largest.

48. *Q.* I thought you were not doing any tank works?—In the three Carnatic districts we are restoring some of the major works.

49. *Q.* Are they filled from the rivers?—No; those we have taken in hand, with one small exception, depend on their own catchment areas.

50. *Q.* You are providing two lakhs of rupees for 38 smaller works?—Yes, for major tank repairs.

51. *Q.* And there are estimates for works awaiting sanction amounting to seven lakhs of rupees?—Yes; one of these is for an impounding reservoir in the Muski valley, a tributary of the Tungabhadra in Lingsugur. The remaining four works are smaller.

52. *Q.* Is it possible to do anything from the Tungabhadra?—There is the Benur project; but there is no other proposal. I think that, with a sufficient supply of water, the area under the Benur project might be extended.

53. *Q.* Not anywhere else?—To no great extent.

54. *Q.* What other channels are there?—There are the two Gungawatti channels situated above Benur; and the Beechal channels situated below.

55. *Q.* Is there no further scope for channels?—I do not think so.

56. *Q.* I suppose that if a large reservoir were made on the Tungabhadra, as proposed, above Hospet, to hold 80 and 100 feet of water, could you improve the area under the existing channels?—The area under Gungawatti and the Beechal channels might be slightly extended, but no new country would be taken up.

57. *Q.* By means, I presume, of a cold-weather supply?—Yes, by means of a cold-weather supply in the existing channels.

58. *Q.* Would you be able to take off no new channels?—No. In reality irrigation from the Tungabhadra on our side of the river is limited.

59. *Q.* If you could store water, could you not extend the area?—I think we should be able to extend it considerably under Benur, and slightly under Gungawatti and Beechal, making some 8,000 acres in all at most.

60. *Q.* You would lengthen the channels?—We should lengthen the Benur and Beechal channels. The irrigable land on our side of the Tungabhadra is limited by the conformation of the country.

61. *Q.* What is the Sirwall tank? Is that one of the 39 works sanctioned?—Yes; and it will cost some Rs. 41,000.

62. *Q.* Is there any possibility of having rain-fed tanks in the Mahrattwara districts?—No. I do not think they

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would be of any use. I propose making large river-fed reservoirs, as the desire of the Government is to improve the drinking water-supply in the Mahrattwara districts. Mr. Dunlop will tell you more about this than I can. Irrigation under such tanks would have to be encouraged in order that the Government should have some return for their money. In years of failure of the rains the water would be conserved for drinking purposes. There is not likely to be more than 1 or 2 per cent. return on such projects.

63. *Q.* Would you tap the smaller rivers?—We should tap only those which had a catchment area of about 200 square miles at the site of the off-take. There are remains of old works in the Mahrattwara districts.

64 *Q.* Are old works good assets?—Yes, as frequently we have nearly to fill in a breach to restore a tank to a state of efficiency; in this manner in the Telingana districts we have had very large returns from very small works.

65. *Q.* The only possible new work of a protective nature in the Carnatic is the Kistna project?—Besides Benur project and the Muski project, both of which are protective, the only remaining large work is the Kistna project and this is a most enormous work.

66. *Q.* What area would it command?—The District Engineer in charge reports that it commands 200,000 acres.

67. *Q* (*Mr. Muir-Mackenzie.*)—Have you thought of a canal on the right bank?—Some few inquiries were made, but the matter was not pushed very far.

68. *Q.* (*Mr. Higham.*)—You would require a very high dam?—I do not think so, but the whole project has not as yet been thrashed out. The area of the land cultivated might be limited by the discharge of the river.

69. *Q* You do not meditate a storage scheme?—No; no such scheme is meditated.

70. *Q.* (*The President.*)—The Deccan project will reduce the low water discharge of the Kistna to practically *nil*. I am of the opinion that the greater part of the hot weather discharge of both Kistna and Godavari comes from the Nizam's dominions. It oozes out of the trap formation.

71. *Q.* Would the Bombay works affect the discharge of the Godavari very much?—No.

72. *Q.* When is the *tabi* crop sown?—The sowing commences in November.

73. *Q.* For how many months is water required for the *tabi*?—The rice crop itself requires water for three months. If a large area is planted, the fields are not sown simultaneously, and thus a supply may be required for four or more months to the whole area.

74. *Q.* Would it be worth the while for the Nizam's Government to consider the question of storage in the Kistna river?—So far as I am aware, no suitable storage scheme could be devised on the Kistna which would be beneficial to the Nizam's dominions.

75. *Q* Is there any site for storage tanks on the Kistna?—It is very rapid all through the Nizam's dominions, and I do not think we could construct a good reservoir there.

76. *Q.* Is anything possible where the Tungabhadra and Kistna join?—No; I do not think anything is possible there. Below the junction the river runs through a gorge in the Nallamallais which is high and rocky country.

77. *Q.* In Madras they are discussing the possibility of making a big dam and reservoir, 90 miles above Bezvada. They contemplate making the *bund* 100 feet above the bed of the Kistna. If that project is carried out, will it result in any good to your side?— I do not know the site exactly; but so far as the locality is known to me, I should say it would do us no good, as the land on our side is high and rocky. I am, however, going there shortly and will inquire into the matter.

78. *Q.* Regarding the Telingana districts, you only repair breaches and put old tanks in order?—Yes; we only repair the old tanks. And the financial results are always favourable.

79. *Q.* Have you any cases of tanks being made *de novo*?—No. We have three such projects; but I do not think they will give such good results, as the old ones we have already put in order.

80. *Q.* Have you any instance of a tank being wholly made afresh?—No; we have no such instance. We have an estimate of a channel which will give 25 per cent. in the Manjira.

81. *Q.* I mean storage works?—No. The Muski is the only such project which is fully prepared. The estimated results amount to 16 per cent.; but I do not think we shall get more than 4 or 5 per cent.

82. *Q* So far as I know, 4 per cent. is considered a good return for a storage tank?—Yes. I do not think we shall get such a good return as indicated in the estimate.

83. *Q.* What credit is taken in respect to these works?—We have no particular system of making accounts. We take credit for the whole rise in revenue due to the supply of water.

84. *Q.* You take an average of five years of the previous revenue and credit yourself with the difference?—Yes.

85. *Q.* Don't the Revenue Department make up the accounts?—No. I make them up myself.

86. *Q.* That is an excellent plan. Suppose you have to incur further expenditure on a tank other than originally sanctioned?—That is added to the capital account. Charges for maintenance only are met from the revenue.

87. *Q.* If you make any considerable repair, you call it capital?—Yes.

88. *Q.* I think they do that in most Native States. Capital account really includes heavy maintenance?—Yes. We have not introduced any proper system of keeping accounts as yet.

89. *Q.* I want to know what value you attach to these percentages?—Revenue authorities give us the returns, and we also have the returns prior to our taking the work in hand.

90. *Q.* Is it the business of any one to scrutinize them?—No.

91. *Q.* It is merely made up for your own information and benefit?—Yes; and also in order to draw attention to any work which does not yield revenue up to our estimate.

92. *Q.* Have you any statement showing the gaugings of rivers?—Only for one river, the Moosi; we are only now introducing the system and fixing up gauges.

93. *Q.* Do you keep up a record of the behaviour of your large tanks in regard to dates on which they fill, etc.?—We have not done so in the past; we are practically now only just making a beginning.

94. *Q.* Is any record of the rainfall kept?—Yes; we keep a record and so also do the Revenue Department.

95. *Q.* (*Mr. Muir-Mackenzie.*)—Under the existing state of things, are we to understand that the majority of tanks in the Telingana district would dry up in a season of drought?—Yes, as at present supplied by their own catchment areas.

96. *Q.* You think they would not fail if connected with the rivers?—No; not if connected with rivers which have a catchment area of 200 square miles at the site of off-take of supply channel.

97. *Q.* Would that ensure their not failing?—It would prevent absolute failure and would ensure water for irrigation for a considerable area. During the late famine the Avanur tanks in Elgandal irrigated their full *ayakat*; they are supplied by a channel from the Maner river which has a catchment area of some 900 square miles at the site of the off-take.

98. *Q.* Even were you to have an absolute failure of rain—a rainfall of 10 inches?—We have never had so small a rainfall as 10 inches. The minimum rainfall we have had during the last 25 years is 17 inches. That was in 1899 I find that the supply to tanks is not so much affected by the vicinity of hills as by the character of the soil in their catchment area. A catchment area of trap hills and black cotton soil ensures a regular and good supply of water to the tank. I have an instance of a tank in the Indur district, called the Kalvarol tank, which has not a very large catchment area (12 square miles), but in the catchment area of which one or two isolated trap hills and a great deal of black cotton soil occurs; the first year we closed the breach in this tank, sugarcane was planted underneath it which speaks well for the rayats' estimate of the perennial nature of its supply.

99. *Q.* It is quite otherwise in the Carnatic districts; they are utterly unprotected?—They are not well protected.

100. *Q.* You have two big schemes in hand: one on the Tungabhadra and one on the Kistna?—Yes; but I do not think the Kistna scheme comes within the range of practical politics for the Nizam's dominions. It is a gigantic affair which will cost a crore of rupees. I hope to carry out the Benur project, which will irrigate 10,000 acres, and the

Muski project which will irrigate 6,000 acres. These two will assist in protecting the Lingsugur district.

101. *Q*. Is that all that is possible?—We intend also repairing the existing tanks.

102. *Q*. What will that add to the irrigated area?—About 10,000 acres, but that will not be available in famine years.

103. *Q*. All that these two schemes will irrigate will be 16,000 acres. The Kistna scheme which will irrigate 200,000 acres is the only hope for any real protection?—I am of the opinion that the smaller schemes mentioned will protect Lingsugur.

104. *Q*. If the reservoir on the Tungabhadra is built, that will play into your hands?—Not very much. The irrigation under Gungawatti, Benur, and Beechal channels might be further extended by some 8,000 acres.

105. *Q*. Besides these, the only material assistance you are likely to obtain is from the big Kistna scheme?—Yes.

106. *Q*. What about the extension of wells in the Carnatic?—I have not studied the subject, but I fear there is little chance.

107. *Q*. The Gungawatti channels have helped in years of scarcity?—During the scarcity of 1897 the Gungawatti channels proved very useful. The work people of 21 villages found work on them during the famine.

108. *Q*. Did the villages under the channels send no one on to relief works?—I cannot tell you for certain, but I am reliably informed that the work people from 21 villages found occupation on the cultivation under the channels.

109. *Q*. The Gungawatti channels irrigate 3,000 acres?—Yes, something under 4,000 acres.

110. *Q*. Can you tell me something about the *dastband* system?—The *dastband* system is employed only for the maintenance of tanks. It is not suited for major tanks, as the maintenance of these tanks requires professional knowledge; but the system is well suited for minor works.

111. *Q*. Are the tanks repaired and then handed over to *dastbandars* to maintain?—This has been done in the case of two isolated major works only. For the rest major works when repaired are maintained by the department. Many tanks which were in an efficient state were given out on *dastband*. In cases where large repairs are required these are repaired by the Government, and, during the period of our operations, the *dastband* is suspended and resumed on completion. As regards other inefficient works given out on *dastband*, the repairs required to which are not so great, I have recommended to Government that the *dastbandar* must be required to bring them up to standard dimensions within a reasonable number of years.

112. *Q*. Did any *dastbandars* take tanks over in a breached condition?—Yes, they did. The system was not worked properly. As only those tanks which were in a fairly efficient state should have been leased out. The Taluqdars misread the instructions and leased out all sorts of tanks on *dastband*.

113. *Q*. Is not 10 per cent. an enormous charge for maintenance?—Yes, it is. Once the tank is put into good order, the Public Works Department can maintain it much more cheaply. The difficulty lies in keeping up an establishment for minor works.

114. *Q*. But given an establishment, do you think it is a good way to keep tanks in order?—I consider the *dastbandar* can only apply to minor works. Given a *dastbandar* interested in the cultivation under the tank, I consider it is a good method, but he must be looked after. If there is no such person available, I would put the tank in charge of the village community.

115. *Q*. How would you look after a village community? In the same way as we look after a *dastbandar*. If the tank is not repaired, we cancel the remissions for the year.

116. *Q*. Does that usually have the desired effect?—Yes; it works well in Indur and Mehdak, but much depends on the individuality of the Taluqdar. The 1st, 2nd, and 3rd Taluqdars are allowed to grant certificates, and these men have the granting of remissions. Some of them grant the remissions without visiting the tanks and merely on the request of the *dastbandars*.

117. *Q*. Would you propose that the certificates should be granted solely by the District Engineers?—I fear they would be unequal to the task. It would require also a large establishment; it would be better to allow matters to stand as they are. But I would recommend a thorough supervision.

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118. *Q*. You think that their work should be carefully checked?—Yes; they require to be looked after.

119. *Q*. Of what does the work of maintenance consist?—The work of maintenance generally consists in keeping the *bund* to a fixed level about the maximum water level and other earth-work.

120. *Q*. Is there any clearance of channels?—Practically none on minor works. But there may be a deal on major works, as, in the event of a tank affecting the cultivation of two or more villages, the main distributary channels are maintained as far as the fields of the last village affected.

121. *Q*. Is there any clearance of prickly pear?—No. We have none here.

122. *Q*. Is there any masonry work?—Practically none. There might be a little dry stone work at times, but you may take it that, on the whole, the work would be mainly earthwork. I have issued certain instructions for the guidance of District Engineers in drawing up plans and estimates for major and minor works which I put in These instructions are mainly based on Colonel Campbell's instructions for the guidance of the tank maintenance scheme parties in Madras; I found these instructions were incomplete and incorrect and so issued these further instructions to provide for where Colonel Campbell's instructions failed. The revenue statement is the basis on which a decision as to the estimate is arrived at. The statement shows the revenue derived for five years before the tank breached or fell into disorder (if possible) and for five years since; also the increased revenue derivable according to the Revenue officer's estimate and the Engineer's estimate. As a rule, we only spend five years' revenue on a tank.

123. *Q*. In these calculations you take the revenue from the *ayakat* less remissions?—Yes.

124 *Q*. You do this in conjunction with the village officers. You get the figures from the Taluqdar and make up an estimate?—Yes; and if there is any difference, we have to correspond with the Revenue officers and obtain the final views of the 1st Taluqdar.

125. *Q*. If your figures are accepted, you take it that the difference between the old and new revenue represents the results of your operations?—Yes; it enables us to come to some decision as to the value of the new work.

126. *Q*. I suppose there is great difficulty in obtaining sanction to works of a purely protective character?—None of such character have been undertaken. The Benur project would be protective as well as productive.

127. *Q*. If the irrigation of 3,000 acres under the Gungawatti channels protects 21 villages, I suppose we may take it that 10,000 acres will protect, in the same proportion, 63 villages. When a tank is repaired, I suppose a large amount of waste land is made available for cultivation?—Not much land which was actually waste; but the land which has gone out of cultivation through the tank breaching or falling into disrepair is taken up again. In many cases there is some further extension and then new land is taken up.

128. *Q*. In Warangal, where the population is sparse, have you found any difficulty in getting wet cultivation taken up?—No. The only place where we have experienced the least difficulty is in Sirpur Tandur. Sirpur Tandur is a remote jungly place and the people are backward and primitive. But in Sirpur Tandur we shall not be able to do very much.

129. *Q*. But you have no fear that in the more developed places all the wet lands will be taken up?—No.

130. *Q*. In regard to the Benur project you would not have that fear?—No. But it might take a little longer to get all the lands taken up than in the Telingana districts. In Lingsugur the soil is mixed, black and red. The land would all be taken up eventually, but not so soon as were the project situated in Telingana.

131. *Q*. I suppose the black soil districts are hopeless?—It is difficult soil to irrigate. We have in Nander a tank called the Sirala tank under which there is much black cotton soil, and we are experiencing much difficulty in pushing irrigation under it.

132. *Q*. What, in your opinion, is the cause of this?—The rayats prefer the dry crop on account of the ease with which it can be sown. Black cotton soil is difficult to prepare for wet crops and decidedly difficult to plough for wet crops, requiring extra strong bullocks to work the plough.

133. *Q*. Is there any chance of using the water from the Wardha river?—I do not think so. I am only personally acquainted with a small portion of it, but I have reliable reports as to the remainder. The conformation of the land

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on either side is difficult. Part of the Wardha runs through the Sir Vicar-ul-Oomrah Jagir.

134. *Q.* Do you see any fear if encouragement is given to the extension of wells in Telingana that the people will refrain from taking up wet lands under the tanks?—So many questions arise and so much interference occurs with the working of tanks. Last year I found that a man had a channel dug from a sluice in a tank to his well, the water was flowing into his well, and out the other side, on to his lands; this land was, of course, being classed as irrigated from wells. The same man had drained the tank almost dry by letting water to waste out of the sluices in order to grow a *tabi* crop in the bed; the *tabi* crop in the bed was supposed to be under wells, but in reality the water was being supplied from a tank above.

135. *Q.* I am speaking of wells outside the area irrigable by tanks?—The instance I have given was situated outside the *ayakat* of the tank.

136. *Q.* But that was a case of flagrant abuse?—Yes; but I fear that so many such cases would arise.

137. *Q.* What I want to know is, if you encourage the digging of wells outside the *ayakat* have you any fear that it would discourage people from taking water from the tanks?—The difficulty would arise in the working of the system, so many abuses would arise; if a well were sanctioned to be dug outside the *ayakat*, it would, if the man were a village officer, probably be dug within the *ayakat*.

138. *Q.* (*Mr. Rajaratna Mudaliar.*)—In calculating increased area of a new project, you say that you take the difference between the "New Revenue" and the former revenue, and that represents the profit. Supposing there was a large area of dry land in occupation, don't you exclude the dry assessment and take the difference between wet and dry?—Our system of accounts is very imperfect still. The course you suggest is the proper one.

139. *Q.* In unoccupied waste lands you would take both the land and water-rates?—Yes. I think we should credit the whole rise in revenue due to the supply of water

140. *Q.* With regard to the *dastband* scheme, would it not be better to vary the rates of remission for different works instead of having a uniform rate?—That has been recommended by some of the District Engineers.

141. *Q.* (*Mr. Muir-Mackenzie.*)—Have you anything to do with a famine programme?—We have no definite orders to compile a famine programme. The estimates already sanctioned and those being framed are considered to be more than sufficient to meet any demands that are likely to be made on us.

MR. A. J. DUNLOP, C.I.E., Revenue Secretary, Hyderabad, Deccan.

(*Hyderabad, 21st February 1902.*)

Mr. A. J. Dunlop.

1. *Q.* (*The President.*)—We have received interesting papers from various gentlemen connected with the Hyderabad State, but we do not know how much attention should be paid to them?—The officers, who have sent in written evidence, have all been specially selected and are qualified to give opinions on the subject of irrigation in His Highness the Nizam's dominions: Moulvie Abdul Kadir is a Subadar, and formerly Taluqdar, who has had many years' experience in the Telingana; Mr. Rai Murlidhar is the Subadar of Warangal and was for a long time on the Board of Revenue; Moulvie Abdur Rahim is Survey Settlement Officer; Shaik Mahomed used to be under me in the Survey Department, but is now Taluqdar of Nalgunda. Of these Moulvie Abdur Rahim is in Hyderabad now; and if the Commission would like to examine him, he can be asked to appear. He is a reliable and intelligent officer. He is now working in the Nalgunda district.

2. *Q.* Generally speaking, the subject of our research in Hyderabad is to find out how far the State is prepared to resist famine and to ascertain what percentage of the country is protected?—May I explain shortly how we stand? The Hyderabad State is divided into two portions, *viz.*, the districts of Mahratwara and Telingana. The former is divided into two divisions, namely, the Carnatic bordering the south-eastern portion of the Bombay Presidency and the north-western portion of the Madras Presidency. A portion of this tract is in the famine zone where, as in Sholapur, there is a scarcity every few years. In the Mahratwara proper, including Aurangabad and other districts, there have been few famines. We had a very bad famine in Aurangabad and the adjoining districts lately, but these districts have not suffered severely for a number of years previously. In 1876 late rain happened to fall in Aurangabad and the crops did not suffer. I generally liken Aurangabad and Parbhani to the Berars.

3. *Q.* (*Mr. Muir-Mackenzie.*)—The famine was very bad in the Berars this time?—Yes; but famine is very rare there. Lingsugur and Raichur are situated in the Carnatic, and these districts frequently suffer from scarcity. Yet the rayats are not so badly off as one would expect to find them under the circumstances. Sometimes they get a bumper crop after a year of drought, and they are so accustomed to times of scarcity that when they have a good crop, they store again for themselves and *karbi* for the cattle against bad times.

4. *Q.* I suppose the population is not very dense?—About 130 odd to every square mile.

5. *Q.* How does this district show up in the census with the rest of the district?—The falling off of the whole dominions was 3 per cent. I have not got the figures by districts.

6. *Q.* (*The President.*)—You generally have an increase?—Yes; we have an increase from 6 to 10 per cent. ordinarily. In 1900 there was great mortality and besides many of the villagers emigrated during the famine and have not come back. In Lingsugur and Raichur there was general scarcity of drinking water in the villages far from the rivers. Water there is frequently brackish, and the people are in great difficulties about it in dry seasons. In Mahratwara there are, broadly speaking, no irrigation works, the people being dependent on dry cultivation and garden crops under wells. The wells are limited in number. There are no protective measures in Mahratwara against famine. We want a survey to see where it is possible to bund up the rivers and *nalas* to store water. During the last famine we lost over 700,000 head of cattle. Practically there is no protection against famine; we do what we can to get wells sunk. In 1310 Fasli we gave 4 lakhs for sinking wells. In 1900, 12 lakhs were given as advances for cattle and seed. I should like to explain our system in regard to wells. In Telingana and Mahratwara the land settlements are different. Mahratwara is on all fours with Bombay. There the people may make wells without permission and at the re-settlement no increased assessment is taken. The land continues to be assessed as dry land. The rayats are encouraged in this way to make wells. In Telingana the case is different. We have so many tanks there on which we are dependent for revenue that we cannot allow the same favourable conditions, because the wells might compete with the tanks. According to the old system well lands were often assessed at the same rate as lands irrigated by flow from tanks, and in one taluka the well rates were considerably higher than the tank rates. Under my advice His Highness the Nizam's Government have introduced certain well rules in the Telingana district which the people have been gradually taking to and which are very much more favourable than the old system. In the last seven years, since the new rules were introduced, 18,502 wells have been constructed.

7. *Q.* (*Mr. Muir-Mackenzie.*)—Is that the figure for Telingana alone?—No; those figures relate to the whole district, but the increase has been largest in the Telingana. I will give you a copy of the statement showing how these new wells are distributed. The new well rules which I put in show the following rates:—

Fifteen years dry rates—15 years at double dry rates; and after 30 years full well rates. (Well rates are about half *ayakat* rates.) We are trying to encourage the sinking of supplementary wells. What we suffer from in His Highness the Nizam's dominions is the enormous amount we have to give in annual remissions. The revenue of Telingana, including wet and dry, is about Rs. 1,17,00,000; but every year, even in a favourable year, we have to give Rs. 20,00,000 remissions. The system is no crop, no revenue. If the rice crops fail, *i.e.*, if there is no water to give the crop, we have to give remissions. If, however, there is water and the rayat does not use it, he must pay the revenue. In ordinary years the remissions amount to about Rs. 20,00,000; but in bad years, like 1306 Fasli, Rs. 42,00,000 were given in remissions, and in the last famine the remissions amounted to Rs. 68,00,000.

8. *Q.* The figures relate to the Telingana district?—Yes; we give remissions every year in Telingana. No remissions are given ordinarily in Mahratwara. We charge

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a rather high assessment, but do not levy it unless there is a crop.

9. *Q.* (*Mr. Higham.*)—What happens if there is only half a crop?—If there is only half a crop, we do not take any notice of the loss. If water is available and it is not taken, the rayat has to pay the revenue. The remissions since 1897-98 have been as follows:—

	Rs.
1897-98	33,00,000
1898-99	28,00,000
1899-1900	68,45,000
1900-01	80,78,000

The great difficulty we have to contend with in making up our budget is to know what the land revenue is likely to be. We know pretty well what it will probably be in Mahratwara where we can collect 99 per cent. except in a famine year.

10. *Q.* (*Mr. Muir-Mackenzie.*)—Was the famine bad in this State in 1896-97?—No; we did not experience a very bad famine; it was really only scarcity; late rains just saved the situation.

11. *Q.* Had you any famine relief works?—Yes; a special report on them has been printed. I estimate that we give Rs. 20,00,000 in remissions in an ordinary year. Now what we want is to find some means for storing water in tanks by means of channels. We want to secure a permanent water-supply. A great deal has been done in the matter of "irrigation" works since Mr. Roscoe-Allen came here, and he has a number of projects in hand.

12. *Q.* Rupees 20,00,000 is 25 per cent. of the revenue?—Yes, about that.

13. *Q.* (*Mr. Rajaratna Mudaliar.*)—Are the remissions in Telingana all on wet lands?—Yes; the dry lands in Telingana are treated in the same way as dry lands in Mahratwara.

14. *Q.* Are the average wet rates higher?—We have no wet rates in Mahratwara. In Telingana the wet rates are higher in some districts than in others. Where the cultivation is good, we have, since olden times, been taking high rates from the rayats; where it is poorer, we charge lower rates. The conditions of land and water are practically the same, but more industry is shown by the people in some districts than in others. This is specially the case in Indur and Mehdak where the rates are highest.

15. *Q.* Is there any difference in the fertility of the soil?—Speaking generally, there does not seem to be any marked difference. The difference is more in the style of cultivation.

16. *Q.* (*Mr. Muir-Mackenzie.*)—Do you test your soil in the same way as we do in the Bombay Presidency?—Yes; we have a regular system, and every field is examined. We make a classification of the soil, and fix a water-rate, in accordance with the prescribed tables, which we have for our guidance. There is no system of separating land and water-rates. A combined rate is charged which includes both land and water cess. The only instance in which we take a water-rate is from *Inamdars* who have free-hold land, but perhaps no right to water, or water only for a single crop and not for the second crop. In such cases we take *dastband*, but it is all credited to land revenue. The safest way of showing the result of irrigation works is to take the increase of the revenue from wet land. This is a test of the work the Public Works Department are doing.

17. *Q.* (*The President.*)—You have a great many *Inamdars*?—Yes; we have many *Inamdars* and a great many *Jagirdars*, some of whom own whole taluqas. Some of the nobles (*Jagirdars*) have very large estates, the revenue from which amounts to about ten lakhs of rupees each per year. They pay nothing to the State, have independent jurisdiction, and manage their own estates.

18. *Q.* Nothing is done for them by way of irrigation?—No; they do it for themselves. I am managing the estate of the late Sir Salar Jung, and we do everything for ourselves.

19. *Q.* In times of famines do these *Jagirdars* provide famine relief for the people?—No; I am sorry to say they do not. The Government of India has commented on this; I think that some means should be devised so as to bring pressure to bear on them in regard to this.

20. *Q.* Have you no statistics in regard to these *jagirs*?—No.

21. *Q.* Have their rayats any occupancy rights?—Yes; some *jagirs* are well managed. In the *jagir* of the late Sir Vicar-ul-Umrah, and in Sir Salar Jung's *jagir*, there is a regular settlement system. On the other hand, in some of the smaller *jagirs*, revenue is taken in grain; but in regard to larger *jagirs*, the Government system of land revenue has been generally adopted, even though there has not been a regular survey. With regard to the maintenance of tanks, the custom in Hyderabad is peculiar. Here we have revised the old native system of *dastband*. Some years ago, before Mr. Roscoe Allen arrived, I found the revenue from irrigated lands decreasing. The Public Works Department was in a most deplorable state as regards irrigation works, utterly unable to cope with the maintenance of tanks; and, as a matter of fact, more tanks were being breached than repaired. Under these circumstances, I asked His Highness the Nizam's Government to revive the old system of *dastband*. The tanks were in most cases constructed in olden days by zamindars, and the object of the *dastband* system was to give them a personal interest in the tanks, so that the repairs would be carried out by them without delay. Since the *dastband* system was introduced eight years ago, we have given out 5,487 tanks affecting an area of 276,000 acres assessed at 29 lakhs and 12,000 on *dastband*. The system is this. The *dastbandar* is a zamindar or *Rusumdar* (a man who receives cash payments from His Highness the Nizam's Government). In olden days these men held the offices of Deshmukhs and Deshpondias, *i.e.*, they were the Revenue officers in charge of parganas, and they managed the lands by hereditary right. The persons to whom we have given the tanks mostly are the persons whose ancestors built them. They are men of property and have a personal interest in the tanks, and generally own a good deal of land below them. We give *dastband* at the rate of 8 to 10 per cent., generally 10 per cent., of the revenue, and for this the *dastbandar* is bound to keep the tank in repair. In introducing the system we meant it to apply mainly to smaller tanks. The scheme has been criticised a good deal, but I believe that Mr. Roscoe Allen is not altogether against it. He has introduced a scheme of annual inspection and report by the Public Works Department, and if the *dastbandar* does not keep his tank in order, he will be come down upon. In my opinion, if the *dastbandi* is well looked after, the scheme will work well. We have so many tanks that the Public Works Department is unable to look after them all departmentally. There have been instances of whole chains of tanks breaching in heavy rainfall. When one tank breached all below it breached also. The *dastbandi* in such cases repaired the tanks in their charge at once, while some of the other tanks have not been repaired even yet. I consider the *dastband* system a very important one. The orders we have given is that no *dastbandar* is to be paid his *dastband* until his tank is inspected. Some objections have been raised to the Tahsildar's inspection of the tanks. I have made a proposal that the tank should be inspected by the Public Works Department officer, or two and three Taluqdars within the first nine months of the year; after that, whether the tank is inspected or not, the *dastbandar* must be paid. The status of the Public Works Inspecting Officer is generally the foreman on minor irrigation works. He collects the hydraulic data and sends a report in to the Sub-divisional Officer, who, if there is any reason to do so, makes a personal inspection.

22. *Q.* What do you find against the system?—Nothing. It works very well if the *dastbandar* is looked after. In some cases the *dastbandars* spend more money than they get. They are interested in the cultivation under the tank, and therefore keep up the storage capacity of the tank. I feel that the *dastband* is the best system for the maintenance of tanks. The *dastbandar* is a *watandar*, and in almost every case he owns land under the tank which has most probably been made by his ancestors. I attach great importance to the *dastband* system and to the *dastbandar* being a zamindar.

23. *Q.* You mean he must be *watandar*, holding an hereditary office?—Yes.

24. *Q.* What is this 10 per cent.?—It is 10 per cent of the land revenue of the year and fluctuates every year. In the Madras Presidency, I understand, the man gets the *dastbandam inam* whether the tank is working to the full capacity or not. We simply give a commission of 10 per cent on the land revenue to secure the tank against loss. When we introduced the *dastband* system, we had no separate irrigation department and the Public Works Department neglected the tanks.

25. *Q.* (*Mr. Rajaratna Mudaliar.*)—What happens when the tanks get silted up?—That difficulty has not arisen generally, but in some cases we have got over it by giving a grant-in-aid for raising the *bund*, which is paid out of the revenue realised.

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26. *Q.* (*Mr. Muir-Mackenzie.*)—Do the rayats like the system?—Yes.

27. *Q.* Is the 10 per cent. paid direct by Government?—Yes; it is paid out of the land revenue.

28. *Q.* (*The President.*)—Is there no fear that the *dastbandar* would levy forced labour?—No. No doubt, the *dastbandar* might pay less than the ordinary contractor for his labour; but being personally interested in the tank, the *dastbandar* would put in better material than some of the contractors would do. It was terrible to see the way in which tanks were repaired and breached before Mr. Roscoe Allen came here. The great majority of *dastband* tanks are small ones.

29. *Q.* (*Mr. Muir-Mackenzie.*)—Are *kuntas* given over under the same system?—Yes.

30. *Q.* Does the Public Works Department advise as to the character of the repairs required?—Yes. I would like to explain another measure which we adopted for putting tanks into repair. We found a great many tanks in disrepair; and the budget grant being limited, the repairs could not be undertaken quickly enough. I consequently obtained sanction to a scheme by which the people were allowed to repair a tank under a contract from the Government, on the promise that they would be repaid from the revenue collected under the tank. We get Rs. 10 per acre and more under these tanks, so that the money expended is soon paid off.

31. *Q.* (*The President.*)—You practically say to the man that if he repairs the tank, you would give him so many years' revenue?—Yes. The work cannot be carried out by the Public Works Department in the ordinary way, without drawing on the Government treasury, to an extent not provided for in the budget. A contractor supplies the money and repairs the tank. He is paid 5 per cent. interest and gets all the revenue from the wet land under a tank until the debt is paid off.

32. *Q.* That is exactly the system the Egyptians have now adopted for their larger works?—Under this scheme we have repaired 1,472 tanks, the Public Works estimates for which amounted to 42 lakhs. I should explain also that in some cases, where a contractor had not enough capital, Government sanctioned the half cash payment system, half the amount being taken from the budget provision. Of the 42 lakhs estimated, 34 lakhs were provided by the contractors and 8 lakhs by the treasury. Sometimes the contractor is paid off in two to five years. The Kamareddi tank repairs cost the treasury nothing, and now the tank yields a full revenue to Government. It was repaired under this system. Of course no *sowcar* would accept 5 per cent. interest for his money, but these contractors hold land and have an interest in the tanks. The repairs on this system are always done under Public Works Department supervision and every procedure is followed according to the rules of the department. Estimates are prepared as if we were going to pay cash in the ordinary way, but instead of cash the whole revenue is given until the amount is paid off *plus* 5 per cent. interest.

33. *Q.* Do the big *Jagirdars* follow that rule?—I am trying to introduce the system in the Sir Salar Jung Estate.

34. *Q.* (*Mr. Rajaratna Mudaliar.*)—Under these 1,472 tanks, what is the area irrigated?—The return prepared does not show the area, but the revenue received from these tanks is 10 lakhs 86 thousand rupees, which has been paid to the persons who repaired them.

35. *Q.* Considering these deferred payments, and the fact that only 5 per cent. is allowed, don't you think that if cash payments were made, the contractors would be able to do the work for less? I do not think so. Besides His Highness the Nizam's Government could not afford to give the money necessary for all the works we wished to carry out at the time this scheme was started.

36. *Q.* Is there any case in which a tank has not paid revenue?—I know of no such case.

37. *Q.* (*The President.*)—At the top you refer to a succession of bad years?—Yes, owing to a continuance of dry seasons some contractors could not afford to wait for their money and so they were paid out of the treasury; those are isolated cases. Ordinarily in dry years, contractors have to take their chances of getting a revenue. But they get their 5 per cent. interest eventually on outstanding amounts. Yes, out of 21 lakhs, we paid 10 lakhs 86 thousand last year. The revenue accounts are recorded in my office.

38. *Q.* (*Mr. Rajaratna Mudaliar.*)—The wet area is not shown in Mr. Roscoe Allen's report. Have you the figures?—I could give you the figures from my office. The last Administration Report for the Hyderabad State is for four years ending 1307 Fasli. It contains full information in regard to that subject and also to the revenue system.

39. *Q.* Can you form any estimate of the area under irrigation in the *Jagirdar's* estates?—No; the information is not available.

40. *Q.* Do the *Jagirdar's* estates form one-half of His Highness the Nizam's dominions?—The Census Report for 1901 will shortly be out and will probably give all the information required. There are 2,899 *Jagir* villages in His Highness the Nizam's territory. The population according to the figures of 1891 in *khalsa* was 8,178,952, in the *Sarfikhas* and *Jagirs* 3,357,498. The *Sarfikhas* is mostly in the Mahratwara country. The figures given in Mr. Roscoe Allen's report of the area irrigated do not include the *Sarfikhas* or *Jagirs*. The *Jagir* tenures are various, but there are two broad distinctions—*Mustusna* and *Gair Mustusna*.

41. *Q.* (*The President.*)—Do the people take *takavi* ordinarily?—No. They do not generally apply for it. They think it is too much trouble to go through the requisite forms.

42. *Q.* Do they look upon it as derogatory?—No; but it is hedged round with too many restrictions and the money has to pass through too many subordinate hands.

43. *Q.* (*Mr. Muir-Mackenzie.*)—Have you tried the system of the Government making the well and charging a wet assessment?—That was our old system in Telingana during the late Sir Salar Jung's time. Money was spent in sinking new wells and the rayats were charged a higher rate; but that was done to a very limited extent, as the Government had not the means to extend the system very largely. Even now we continue to receive applications for the Government to repair wells and charge a wet rate; but we advise them to repair the wells themselves, as the field-holder has the hereditary occupancy of the well attached to the field.

44. *Q.* (*Mr. Rajaratna Mudaliar.*)—Have you any statistics as to the total number of wells, old and new, in the Mahratwara and Telingana districts?—There were 78,087 wells up to the end of the year 1302 Fasli in *khalsa* lands; there are now 96,589 wells.

45. *Q.* (*The President.*)—Do they go in much for *kachcha* wells?—There are a great many in the Telingana districts which are only used in dry years.

46. *Q.* Does the list include *kachcha* wells?—The list includes all wells fitted with *mots* whether *pakka* or *kachcha*.

47. *Q.* Is the water service very deep in this country?—It varies very much. In Telingana water is near the surface. In Lingsugur it is much deeper. In Telingana the average irrigated area is two acres to a *mot*.

48. *Q.* May we take it that the irrigation is all from wells in Mahratwara?—Yes, nearly all.

49. *Q.* How did the wells behave during the times of drought?—Many of them failed.

50. *Q.* Was any attempt made to deepen them?—Yes. We started to deepen them, but there was a great prejudice against this measure during the famine. A rumour got about that water was lost by deepening wells and so widespread was this feeling that I cancelled the order for deepening wells that still had a little water in them.

51. *Q.* You lose the spring or something happens to divert the water?—Yes.

52. *Q.* (*Mr. Muir-Mackenzie.*)—Do I understand you to say that in Mahratwara the assessment on wet land does not exceed the dry rate?—This is the case only in regard to new wells. The old wells are assessed at *bagayet* rates.

53. *Q.* (*Mr. Rajaratna Mudaliar.*)—Has there been a very large increase in the number of new wells in Mahratwara?—No; not to the extent I expected.

54. *Q.* (*The President.*)—What is the total cultivated area of the State?—On page 28 of the Administration Report the total cultivated areas are given, and on page 29 of the same report the total remissions are shown. To arrive at the net area cultivated, we must deduct the remissions from the cultivated area.

55. *Q.* (*Mr. Muir-Mackenzie.*)—Am I to understand that the actual area under irrigation can be arrived at by taking the difference between the cultivated area and the

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area on which remissions have been granted?—Yes; if you deduct the remissions, the balance is the actual area cultivated in the year referred to, but it varies very much on account of the rainfall. In Telingana we are obliged to take the average of several years when making such calculations.

56. *Q.* That is the nearest approximation we can get to the actual irrigated area?—Yes; as a rule, remissions are given on wet lands.

57. *Q.* Is Telingana completely protected against any drought which is likely to occur?—No; because, if we had a year of serious drought, the tanks would be dry. In that case we would be as badly off in Telingana as in the Mahratwara.

58. *Q.* At the same time the Telingana district did not suffer during the last two famines?—No; there was no actual famine there, as some rain fell. The distress, such as it was, was caused by high prices of grain.

59. *Q.* Has there been no famine there since 1877?—No, with one exception, *viz.*, the Nalgonda district. In 1876-77 the famine was pretty bad there. In my opinion the Telingana districts are not protected; and if a severe drought were to occur, the tanks would dry up.

60. *Q.* But you have always had rain there?—Yes, but the quantity varies. Last year we had to give 68 lakhs in remissions instead of 20 lakhs as in an ordinary season.

61. *Q.* That refers to only half of the State?—Yes, and to some talukas in the Gulbarga Division.

62. *Q.* Suppose some of the tanks in Telingana were linked with the rivers by channels, would that not be a great help?—Yes, Mr. Roscoe Allen has some schemes of this nature in hand.

63. *Q.* Do you think that, if the tanks were connected with the rivers, they would fill in years of drought?—Yes; we have the Moosi, which should be useful to the Nalgonda district; and Mr. Allen has a scheme for making use of the Maner and Manjira rivers which can always be depended upon.

64. *Q.* On what grounds can they be depended upon?—Because they generally have water running sufficient at least to fill the tanks in a dry season. In Mahratwara there are no tanks and no large storage works. The Telingana districts are covered with tanks.

65. *Q.* Do you think that there are no tanks in Mahratwara, because there is black cotton soil there?—Yes, to some extent; but the Marathas do not take to wet cultivation like the Telugus, who place great reliance on irrigation. The Marathas will not take up wet lands under tanks in Telingana. This is a peculiar fact. They do not like wet cultivation. In the Berars, where they have tanks, and where I served for fifteen years, they will not use them for irrigation. In Mahratwara they do not use the tanks, because there is black cotton soil, which in an ordinary year produces luxuriant dry crops.

66. *Q.* The census for Warangal is rather perplexing. The figure shown in 1901 is 11·67 per cent.?—The census enumeration of 1891 is probably more correct than 1881; but the figures are probably not much wrong, as Warangal was very backward some years ago, before the railway was constructed. After the railway was opened, the district made great advances, and indeed was quite transformed, and has now become a most flourishing one.

67. *Q.* But the population is still only 85 per square mile?—Yes; there are enormous areas of forests, where there is little or no population.

68. *Q.* The development of the districts is due to the railway?—Yes, and to the survey settlement. In one taluka the survey settlement was so successful that increase in revenue in one year mainly by extension of area almost paid the cost of the survey. Many irrigation works have also been restored.

69. *Q.* There was not much restoration before 1891?—No; very little.

70. *Q.* In Mahratwara how were the people employed during the famine? Did you have any irrigation works?—No; there were no surveys, and no irrigation schemes ready. No means for making tanks. The Irrigation Department does not work in Mahratwara, so I had no means of employing men on tanks. We had earth-works of two railways and roads. We also deepened one or two village tanks.

71. *Q.* Do you expect to employ famine labour elsewhere?—My idea is that we should have a regular survey made, and make a programme of irrigation works for Mahratwara, where there is a necessity for them, as a protection against famine.

72. *Q.* Is that district not supposed to be hopeless in regard to irrigation works?—I do not think there is a possibility of making very large tanks there; but it is impossible to say without a survey. There is nothing I should like to see famine labour employed upon better than on tank works; but we had no data or anything to go upon during the last famine.

73. *Q.* With reference to what you said yesterday, with regard to less favourable terms for wells being given in Telingana than in Mahratwara, because in the former wells competed with tanks, why should there not be liberal terms for wells outside the tank *ayakat*?—Because the population is sparse, and is not enough for both tanks and wells.

74. *Q.* It is just the matter of sparseness of population?—Yes; if the population was sufficient, there would be no object in specially assessing wells outside the *ayakat*. It is only in comparison to the Mahratwara that the wells outside the *ayakat* are less favourably treated. Compared with the assessment of previous years the present assessment at well rates is distinctly light.

75. *Q.* Are there any supplemental wells?—Yes, but they are used only in bad years when the tanks fail. We encourage the people by charging only the usual half the assessment.

76. *Q.* (*The President.*)—They won't pay that half if they began with tank water?—There are rules laid down on this point for the guidance of officers. If the water-supply is generally a mixed source, partly tank and partly well, the Settlement Department lowers the assessment permanently. In other cases the Jamabandi Officer can make reductions under special circumstances.

77. *Q.* (*Mr. Muir-Mackenzie.*)—Would you mind explaining the *dastband* system again?—A man guarantees to maintain a tank in good order, and keep it up in its existing state of repair, and in return we give him 10 per cent. of the revenue. In some cases of large tanks we consult the Public Works Department and only 7 or 8 per cent. is given.

78. *Q.* Are they handed over in good repair?—If there are small repairs, the *dastbandar* does this, but sometimes we do it ourselves. We also have a new scheme under which the tanks are repaired by the Public Works Department. Sometimes considerable improvement in the tank has to be made, and the question arises whether the *dastbandar* should carry it out. In such a case the *dastbandar* is given the option of repairing it. The following rule applies to the matter:—

"The *dastbandar* should be given the option of carrying out the improvements, according to the new scheme, he being repaid the outlay from the revenue of the tank. If he refuses the contract, and if it is desirable that the improvement should be effected, the *dastband* lease should be suspended for the time being, and the work should be carried out through any other person according to the new scheme. When the work is completed and outlay repaid, the *dastband* lease can be revised." This rule was framed in order to meet the cases in which *dastbandars* were given tanks before the Public Works Department had inspected them. The new rules have now been working since February 1899.

79. *Q.* Are there any tanks not maintained by either the Public Works Department or the *dastbandars*, and what is done for them?—All tanks not maintained by *dastbandars* are supposed to be maintained by the Public Works Department; but they are too numerous to be well looked after by the Public Works Department.

80. *Q.* Do not you think that the tank should be repaired by one or the other?—Certainly; I am strongly in favour of the *dastband* system, as I think that the personal interest of the *dastbandar* in the tank is an important factor and makes him a more useful agent than petty officials of a large department.

81. *Q.* Is not the percentage given very high?—No; it is not too high. The channels under the tanks are kept in repair by the *dastbandar*, who ensures Government also against future loss. One year's revenue from these tanks is equal to 10 years' *dastband*; and if a non-*dastband* tank breaches and is not at once repaired, it can be seen how much revenue is lost.

82. *Q.* Is the supervision of this system reliable?—The system of Inspection is complete. It provides for inspections being made by the Assistant Tahsildar, District Engineer or Foreman in the Public Works Department.

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83. *Q.* Can the check be relied upon?—The whole system depends on the district officers and the self-interest of the *dastbandars*. If the latter does not keep up the tank, he loses his *dastband* and the water for his fields. When I first came to Hyderabad and for a good many years afterwards in the olden days, little or no notice was taken of applications for repair of tanks, and they remained unrepaired for years greatly to the loss of Government. This does not happen under the *dastband* system.

84. *Q.* The only weak point seems to be that the revenue of the tank is not a very good indication of the difficulty of maintaining it, *i e.*, a big tank may have a short *bund*. The *bund* of a tank, 600 feet long, would cost nothing to repair. On the other hand, a large *bund* might bring only a small revenue?—No lease is given now without the sanction of the Public Works Department. The Chief Engineer fixes the amount of maintenance, at so much a year for maintenance. The Revenue Department works under the advice of the Public Works Department.

85. *Q.* I understand that you are desirous of extending the wells in Mahratwara. Do you propose to advance money liberally for that purpose?—I hope the people will come forward themselves. We cannot afford in this State to give very large advances. As a matter of fact, we have given large advances lately.

86. *Q.* Would you be prepared to borrow it at a lower rate of interest than you lend?—I do not know what the Financial Secretary will say to that. I would like to see large advances given.

87. *Q.* Do the people take advantage of *takavi*?—My experience is the same as it was in the Berars, *viz.*, that the people do not like to ask for *takavi*.

88. *Q.* If you had a special officer to work it, do you think it would be popular?—It might be if we had good men to work it. We discussed the question of Agricultural Banks here some time ago.

89. *Q.* I do not mean anything so large?—We had something of the kind during the famine, *i.e.*, some special officers were entrusted with the distribution of advances.

90. *Q.* If you had the money, would you be prepared to go on with it?—Yes, if we had the money, which at present we have not. I would recommend it for Mahratwara as well as for Telingana. In Telingana our great object in increasing the number of wells is not only to protect the country, but also to obviate the large fluctuations in revenue caused by annual remissions. Extension of wells and channels is the only means of obtaining fixity in the revenue in the Telingana.

91. *Q.* Is there any part of the dominions in which the people put up field embankments?—No, *Asmanidurri* to some extent; but I have not seen the *tals* here you refer to.

92. *Q.* I thought there might be some in Lingsugur?—I have not come across any.

93. *Q.* In Aurangabad there might be room for these?—I do not remember seeing any there.

94. *Q.* You advocate a survey for the purpose of ascertaining good sites for big tanks. You also recommend a survey of the subsoil water supply?—It is difficult sometimes to find out where to sink a well. After undergoing great expense, no water may be found, or it is brackish.

95. *Q.* (*Mr. Rajaratna Mudaliar.*)—In regard to supplemental wells in the *ayakat* of tanks, supposing the tanks are dry, and the crop is raised by the well, what will you charge?—We charge the well rate which is generally half the wet assessment. We never charge for a tank rate when a well is used.

96. *Q.* What assessment do you charge outside the *ayakat*?—Certain well rates are laid down according to the classification of the soil, depth of water, etc. The well rate, as a rule, is about half of the tank rate. If the well is used annually as a supplement to the tank, the Settlement Officer permanently lowers the classification on which the assessment is based.

97. *Q.* On *ayakat* wells *jamabundi* is made every year. The well may be used for only a month or for a whole time. If you use it for whole time, it is assessed at half the tank rate. So every year your officers determine for what period the well water was used?—The *ayakat* land is assessed as tank land unless there are permanently-used wells; but the rayat comes forward, says he has used a well. The Revenue officers are empowered under certain defined rules to give remissions.

98. *Q.* You said that special facilities are given to the rayat for the construction of wells in wet lands rather than in dry lands. In what way are the facilities greater in wet or in dry lands?—I did not say that they were greater; but, as a matter of fact, wells are generally sunk in the *ayakat*.

99. *Q.* I was under the impression that you said you discourage the sinking of wells in Telingana?—No. In Telingana permission is necessary to sink wells, and after a certain period a well rate is charged on the land irrigated. In Mahratwara no permission is necessary, and no extra assessment is charged for the land irrigated from the well.

100. *Q.* If an application was made for wells in Telingana, do you refuse permission?—No; we never refuse permission.

101. *Q.* Is not the cost of raising the water by mechanical appliances prohibitive?—No; the water is near the surface, and the cost of raising water is not prohibitive.

102. *Q.* Don't you think that the rayat would rather take water by flow than by lift?—Certainly. But if the tank has only a little water, the question of distribution comes in. If the rayat begins cultivation under a tank, he does not know whether he will get water when he wants it most for his crops. If he is using a well, he knows that he can get water for the whole period. This uncertainty regarding the distribution of water under small tanks at least is a factor in favour of well cultivation.

103. *Q.* In Mr. Roscoe Allen's report, on page 11, he says that an expenditure of Rs. 3,96,800 has been made since October 1896, under the head of "Minor Works." Do you find any increase in the area and revenue due to this?—I cannot say whether any increased area would be irrigated. The remissions would be less; but there would be no other figures to indicate an increase in the revenue.

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DIWAN GUR BAKHSH ROY, Chhatarpur State.

1. The population of the State according to the Census of 1901	156,239
	Miles.
The gross area of the State	1,118
	or 715,520 acres.
	Acres.
Cultivated or occupied area	163,516
Area irrigated by State works in normal years	1,466
Area irrigated by State works in year of drought	965
Area irrigated by private or village works in normal years	1,704
Area irrigated by private or village works in year of drought	1,041
Area irrigated by wells—	
(1) In a normal year	36,742
(2) In a year of drought	31,462

Returns showing the total area under crop were not, as a rule, made every year; hence average area annually under crop cannot be exactly known; but the average area annually under crop during the last ten years might be about 4 or 5 per cent. less.

The figures given above for areas of land irrigated by State works, private works or village works in a year of drought, as contrasted with those for irrigated land in a normal year, are for the famine year of 1897. In that year there was no complete drought; we had 41·03 inches of rain, and so, although owing to the early cessation of rains, all the *kharif* crops, with the exception of *juar*, were nearly completely destroyed, we had pretty fair *rabi* harvest. Had the rains completely failed, we could have almost no *rabi* harvest, and the disastrous effect of famine would have been very serious. The figures therefore for irrigated area vary immensely with the severity of drought; the more severe the drought, in other words, the smaller the amount of rain, the smaller the area irrigated, and in a year of complete drought we may have nearly no irrigated area to grow our crops upon.

The difference between the figures given above for irrigated areas by State works in a normal year and a year of drought respectively does not indicate the actual difference between the two. As the area shown for the normal year not only includes lands irrigated by State works by men of canal system, but also includes the area which has recently been brought under the *bandh* system irrigation.

2. The approximate relative proportion in which the different kinds of soil, such as *mar*, *parua*, *rankar*, occur in the State is as follows:—

Mar	12·5 per cent.
Parua	20 "
Rankar . . .	67·5 "

Mar is not unsuitable for irrigation, but the people generally do not care much to irrigate it—

(*1stly*) Because *mar* land is said to possess the property of retaining moisture for a long time and can therefore, without the help of irrigation, produce valuable crops, such as wheat, gram, linseed, *arhar*.

(*2ndly*) Because no irrigation is required for growing *kharif* crops, such as *juar*, *kodoun*, oilseed in *mar* land.

(*3rdly*) Because *mar* land is subject to clearage; large cracks or fissures are formed in it, and they absorb considerable quantity of water; and, as a consequence, much larger quantity of water is required for irrigating *mar* fields than they naturally require.

(*4thly*) The presence of more than sufficient moisture in *mar* land makes wheat and linseed liable to rust or injure the standing crops in other ways. In places where there exists a well in *mar* land ordinarily, the outturn of produce by means of irrigation is much larger than that in unirrigated *mar*.

Good *parua* is suitable for irrigation, but it is not to be found in extensive pieces; for the most part all the wells lie in inferior *parua* and good *rankar*. Irrigation by itself cannot render these *parua* and *rankar* productive; they have to be manured almost every year; and even with the aid of manure and irrigation, these soils produce simply barley and little wheat.

Black cotton soil is prevalent in Londi Pargana and in the northern part of Chhatarpur. In small bits it is found scattered in other places too.

Its usual depth is from 5 to 7 feet in Londi and northern part of Chhatarpur where *mar* prevails.

The underlying stratum is the rocky soil called *rankar*.

In some places *parua*, mixed with limestone, is found to intervene between the actual *mar* and *rankar*.

Besides *mar*, *parua*, and *rankar*, there is a class of blackish soil which in its properties for the most part resembles *mar* and has therefore been included and treated as *mar*.

Cultivators do not desire to irrigate *mar* for reasons explained above.

Statistics of rainfall.

Year.	Inches.	Cents.
1885-86	30	13
1886-87	39	90
1887-88	38	88
1888-89	66	40
1889-90	37	11
1890-91	57	39
1891-92	49	62
1892-93	54	52
1893-94	46	43
1894-95	68	41
1895-96	37	59
1896-97	43	59
1897-98	41	·03
1898-99	59	93
1899-1900	37	61
1900-01	42	16
1901-02	44	36

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3. The accompanying table will show—

(1) Staple crops grown in each main class of soil.

(2) The crops which require irrigation.

(3) Times at which sown and reaped.

(4) The number of waterings required.

Rental of irrigated and unirrigated lands is as follows:—

Land irrigated.—The amount of rent varies with the productive capacity of the soil. Irrigated land for the most part consists of land irrigated by means of well water. The rental of this well irrigated land is fixed generally once for ever in a lump sum which the cultivator has to pay to the State annually. This lump sum is, according to circumstances, subject to some variation; but this variation is resorted to when there are potent reasons for doing so. This rental varies from annas eight to Rs. 2-8 per *bigha*.

The land irrigated by tank water is limited; its rental varies from annas eight to Rs. 1-2 per *bigha*.

The rental of *bandh* irrigated land varies from annas eight to Rs. 2½.

Rent of land unirrigated—

	Rs.	A.	P.	Rs.	A.	P.	Per *bigha*.
Mar I . .	0	2	0	2	4	0	"
Mar II . .	0	2	0	1	12	0	"
Parua I . .	0	2	0	2	3	0	"
Parua II . .	0	2	0	1	8	0	"
Rankar I . .	0	2	0	1	12	0	"
Rankar II . .	0	2	0	1	0	0	"
Cachar . .	0	4	0	2	0	0	"

Note.—Rents of irrigated and unirrigated lands also vary to a certain extent according to different crops sown.

The State's share is taken ordinarily in cash; to some extent it is taken as a share of the produce; but it is not taken in kind, but at its cash valuation.

The State's share varies from 16th in case of coarse grains to ⅓rd in case of *rabi* crops, whether on irrigated or unirrigated lands.

4. *Famine, Sambat 1888.*—No written reliable record; but on the authority of living aged persons it appears that *kharif* crops were injured by locusts and rainfall was insufficient; food grains were procurable with scarcity and there was some mortality due to starvation.

1894	Kodoun and other *kharif* crops failed; hence famine.
1925	Rain failed; hence famine.
1953	*Kharif* crops failed; hence famine.

Scarcity—

1890	Wheat was injured by rust, hence scarcity.
1930	Wheat crops completely damaged by rust; hence scarcity.
1934	Partial scarcity by partial failure of rain.
1949 1950	Wheat crops damaged by rusts.
1952	Partial scarcity.

Some villages in Deora Pargana, which are situated at the top of the Vindhyia Range, where there are no wells, are most liable to famine. Owing to the mountainous and rocky nature of the soil arrangements cannot be made to dig wells, construct tanks, or bring water by means of a canal from some artificial reservoir of water.

Places where soil is of bad kind of *rankar*, and wells do not supply sufficient water for irrigation purposes, are also liable to famine. Such sort of soil is not situated in any special part of the State; it is scattered in pieces belonging to villages of different parganas.

5. There are no big irrigation works in the State; only two State tanks, *viz.*, Jagat Sagar in Mow and Jhunia tank in Pargana Landi, serve the purposes of irrigation to a limited extent.

These tanks were constructed in ancient times; therefore no records can be found to show the cost of their construction.

These two tanks are storage works.

There are no works taking off water direct from rivers.

Area irrigated by these works is about 150 acres, and the revenue realised annually by means of them is Rs. 882; both these items are so limited that they can have no perceptible effect upon the financial condition of the State

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nor have any perceptible protective results been attained by means of them.

Irrigation revenue is realised from cultivators for the water taken by them in the case of Jagat Sagar tank only; its rate varies from annas eight to Rs. 1-2 according to the nature of the soil for which water is taken.

No water-rate is levied on cultivators utilising the Jhunia tank water.

Ordinarily no remissions are given in water rates when crops fail to come to maturity; remissions are made in the rent of land. The cultivators can claim remissions of water-rates only in cases when they cannot get sufficient supply of water for irrigating their fields.

These works are maintained in their proper order by yearly or periodical repairs.

At the Jagat Sagar tank special official is kept, and the business of distribution of water is entrusted to him. The Tahsildar keeps general supervision.

State works do not irrigate *jagir* lands.

Jagat Sagar tank has got more water than required at present for irrigation, but there is no land near about; for the irrigation of wheat the excess of water might be utilised.

Jhunia tank sluice requires some repairs. There has gone something wrong with it inside, and the efforts to prevent leakage have hitherto not been successful.

There are other small tanks in the State which irrigate lands; but as the quantity of land irrigated is very small, they have not been mentioned here.

Bandh irrigation system has been treated under 9—Field Embankments.

6. No new State works have yet been proposed. In March last Mr. J. G. White, Superintending Engineer, Rajputana and Central India, inspected course of the river Ken (which runs along the eastern border of the State) in the Chhatarpur Pargana of Deora and Bijamber territory to find out a suitable site for the storage of water, and was pleased to suggest that at a place near Dhondan, a village in this State, where the river runs through a very narrow channel, a wall might be built 100 feet high across the river channel to restrain the water of the river. The water thus restrained and collected in a large pool would, the Superintending Engineer thought, suffice to irrigate large area both in Chhatarpur and Charkhari extending over many miles. The cost of this work is estimated by him to be nearly 30 lakhs of rupees. With reference to the Agency's inquiries on the subject, the Durbar had informed the Agency that the Durbar would like to have further necessary inquiries made in connection with this scheme. The Durbar is not yet aware how far the inquiries have proceeded. As soon as the Durbar is favoured with information as to what course the canal and its distributaries are proposed to take, what kinds of soil they are to pass through, and what benefits are likely to be derived from the new project, its working expenses, etc., the Durbar will be in a position to form their opinion about the project.

7. There is only one irrigation tank in the *jagir* village of Mulia. This tank is situated partly in Chhatarpur territory and partly in Bijawer. In Chhatarpur it irrigates 107 acres of land. The tank contains more water than is actually needed at present; and the Amin, who was deputed to inspect the tank and make report on it, says that if the *bandhan* is raised a little higher and a small bridge is made on the outlet, 43 acres of land can be brought under irrigation.

The *bandhan* does not stand in need of special repair. The tank is likely to fail with the failure of rains; but since the catchment area of this tank is very large, compared with its present capacity to hold water, partial failure of rain can have no perceptible effect upon the quantity of water ordinarily contained in the tank.

The *jagirdars* are not generally so well off as to afford to incur the expenses of making such works elsewhere, nor there is any possibility in tracts most liable to famine of digging wells or of making reservoirs for storage of water for irrigation purposes.

8. Average depth of water 30 feet below ground surface.

Cost of wells used for irrigation. Ordinary sort of *pakka* well with arrangements for one *tarsa* used for irrigation costs Rs. 80.

Total number of such wells—

	Rs.
Pakka wells . . .	8,836
Kachcha wells . . .	1,825
Total .	10,661

In this country the supply of water in wells entirely depends upon rainfall; wells supply water in proportion to the amount of rainfall in that particular locality, and this supply is affected more or less by the nature of the soil in which the well lies. In years of normal rainfall the water-supply in about 10 per cent. of the total wells runs very short. In years of complete drought it is most probable that about 90 per cent. of the wells would be altogether dry.

No State irrigation works, if *bandhs* are to be excluded from the category, have been constructed other than wells within the last 10 years.

Rupees 8,753-8 have been given as a loan to cultivators for digging wells.

In places where large irrigation works, such as canals from ever-running rivers or big reservoirs of water, are impracticable owing to (1) the uneven and rocky surface of land in the Dangai or forest portion of Bundelkhand which is almost everywhere studded over with hills and which in many places is cut up by ravines; (2) the absence of ever-running streams such as the river Ken which, however, flows upon a bed too deep to allow its water to be utilised for irrigation purposes by means of canal system, experience shows that irrigation by means of wells is the best way of improving the productive capacity of the soil.

The ancients fully recognised this fact, and at present too every effort is being made on the part of the State to stimulate the digging of new wells wherever possible. A reward of Rs. 15 is given by the State for every new *pakka* well (the average cost of which with arrangement for one *tarsa* is nearly Rs. 80) that is made for irrigation purposes unless the maker is unwilling to take it. *Takavi* loans to be repaid in easy instalments fixed according to circumstances, bearing an interest of one per cent., which the State now proposes to reduce to annas eight, are freely given. No interest is charged on a loan of Rs. 15 which, as a reward, is set off against this item when the well is ready.

In several places the State has dug and built wells at its own costs and made them over to cultivators.

Obstacles, however, lie in the way of free extension of irrigation wells; since in many places the hard rock occurring inside the wells obstructs the digging of wells or of their reaching the depth where water is obtainable.

The occurrence of hard rock inside is very uncertain, and it is this uncertainty which has baffled the attempts of many a cultivator to dig wells, in places where they thought their digging would be attended with complete success and has brought ruin upon many.

There are persons to be met with here and there who with the skill at their disposal, foretell what places would be devoid of hard rock, and therefore most suitable for digging of wells, and sometimes their prediction turns out to be correct too.

To facilitate the task of ascertaining the existence of hard rock inside, the State contemplates giving trial to the scheme of boring.

The ancients were fully cognizant of such obstacles. To compensate for this natural drawback, the ancients devised schemes of making, on small scales, artificial tanks by damming streams for the storage of water in the rainy season for their own as well as for their cattle use and to indirectly serve the purpose of irrigation by recouping the natural deficiency of water in adjacent wells. It is to this clever device of the ancients that our country is blessed now with tanks and with human habitation; thus we see that, for the most part, the villages are situated on the banks of tank or near some stream.

9. Field embankments are made by cultivators for the purpose of holding waters to moisten the soil.

These embankments are more or less suitable to all kinds of soils, *mar*, *kabar*, *parua*, good *rankar*. In the *mar* lands the cultivators grow wheat (Kathia); in *parua* and good *rankar* they grow wheat (Pisia) and barley. This system of making field embankments has lately greatly developed and assumed the new aspect in the Landi Pargana. People now construct *bandh* across streams, large and small. These dams or *bandhs* are wholly made of earth, and they serve to check the flow in the rainy seasons of water in the stream and to make it collect within the limits of the *bandh* area. The excess of water, if there is any, escapes at the corners or the extremities of the *bandhs* which are rounded and made of masonry work just to prevent the *bandhs* from being gradually cut up and washed away by the force of water running out. This stored-up water is kept confined within the limits of the *bandh* area till the end of the rainy season when the whole water is let out through a *pakka* drain which runs right across the breadth of the *bandh* at some convenient place in it. The opening of this drain into the reservoir is closed on the commencement of the rainy season by means of a big earthen pot; and when the time comes for letting out water, the earthen pot is broken by the stroke of a piece of bamboo. The whole water then rushes out, leaving the *bandh* area empty. The whole *bandh* area which was hitherto submerged under water is then ploughed once or twice and then sown. The central portion of the hollow area yields the largest produce, but the produce in the surrounding lands gets smaller gradually, as the land recedes further from the central portion.

Advantages of *bandh* system of irrigation—

(1) The outturn of produce in areas, attached to these *bandhs* is much larger than that in well irrigated areas or similar areas watered by canals.

(2) Once the seed is sown in *bandh* areas, the cultivator has no more to irrigate the land, and is therefore saved the trouble and expenses which well irrigation entails.

(3) The cultivators need not any more manure the area brought within the influence of *bandh*, since this area is naturally manured by the organic matter which is washed down into the *bandh* by the stream itself and which settles on land and is soon converted into manure by the action of heat, air and water.

(4) The land submerged under water has all the vegetable matter, such as *kans*, brambles, and bushes destroyed by the action of water.

(5) We see in the construction of *bandhs* that in case we can manage to construct dams across streams large enough to hold the whole water that runs down its banks along its entire course, we also manage to prevent the organic matter mixed with fine earth belonging to the whole catchment area of the *bandh* and stream from being washed away by the current. This constant washing away of the rich silt annually from the catchment area of a river or stream is doing harm to the productive capability of the surface soil, but by the gradual extension of the *bandh* system we hope to remedy this evil.

(6) The irregularity in the distribution of rainfall as regards time can have no effect upon the produce of *bandh*.

(7) Land uncultivable owing to its lying on the banks of the bed of stream is by means of the *bandh* brought under cultivation.

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A reward is given to the maker of a *bandh* if he wishes to take it at the rate of two rupees per *bigha*.

The first *bandh* in Landi was made in the time of late Maharaja Pertap Singh Bahadur. This example was followed by cultivators, but till the year Sambat 1940 only a few *bandhs* were to be seen in the whole pargana. A few years after Durbar's attention was drawn to the importance of these *bandhs*, and three or four *bandhs* were built and completed before the famine year of 1897. Two or three of these *bandhs* were started to give employment to persons who stood in need of it owing to scarcity of corn which followed, as a consequence, the rust of 1849 and 1850. Several big *bandhs* were made by the State, and they were followed by the construction of many more by the cultivators themselves.

If the *bandhs* continue to be made at the rate at which they have hitherto been done, a bright future lies for the Landi Pargana.

Making of *bandh* was attempted in other parts of the State, but was not attended with the same success.

The only disadvantage is that it renders wheat crops liable to rust in wet years.

Attempts have also been made to convert old tanks into *bandhs* by making repairs to the broken *bandhs* and hitherto they have proved successful.

10. *Q.* The accompanying table will show the number of works on which relief labour was employed during the late famine.*

No irrigation works, such as canals from rivers or from storage works, were commenced and completed. But *bandhs* were made in places in the Landi Pargana and they afforded useful employment to relief labour. Relief labour might in future be usefully employed in improving and strengthening the existing *bandhs* as well as *bandhs* that might be proposed for construction hereafter.

The works proposed by Captain Ewbank constitute our programme at present of relief works.

Small *bandhs* in fields or field embankment are suitable to limited extent for the employment of relief labour. As a general rule, these embankments are made by cultivators themselves.

CAPTAIN F. G. BEVILLE, Political Agent, Bundelkhand.

(*Gwalior, 10th December 1902.*)

Captain F. G. Beville.

1. *Q.* (*The President.*)—You are Political Agent in the Bundelkhand State?—Yes.

2. *Q.* How long have you been there?—Two years.

3. *Q.* You have been long enough to know them pretty well?—Yes, somewhat.

4. *Q.* How many are there?—Twenty-three in all.

5. *Q.* Can you speak of Captain Ewbank's work; was the work he did in estimating for dams, etc., serviceable?—The scheme was drawn up just after the famine of 1897, and after that Captain Ewbank was deputed to the agency to draw up a scheme of protective works, but the works suggested all required a masonry face, and are therefore not suitable as famine works; his estimate of profit is higher than we can expect; unless we can induce a State to see there is profit in a work, they won't take it up; in the famine they made many works that were of little or no productive value.

6. *Q.* Did Captain Ewbank carry any persuasion with him; was he thought much of in the States?—Yes.

7. *Q.* His schemes are rather protective than relief schemes?—Yes.

8. *Q.* He went in for a stone wall in every case?—Yes; it is not a good work for famine.

9. *Q.* Have any of them been carried out?—No.

10. *Q.* Where is Captain Ewbank; do you know?—I think he is in the Punjab.

11. *Q.* Are the States in a position to carry on any works?—Small works, not big ones; the States suffer from want of professional advice; they are small and cannot afford an expert engineer to look into plans and estimates and select sites; that is one of the great failings we have in the Agency. I think we require an officer for all the States in combination, and not for an individual State.

12. *Q.* Would the States consent?—There is a sufficient number under Government who could do it.

13. *Q.* The Orchha Raja is well disposed towards this; is he not?—Yes; he takes a personal interest in irrigation schemes; one of the difficulties is that he cannot get enough people to take up the ground that he has prepared for irrigation; a large tank was made and the cultivators were offered low rents to take up the land under it, but he has found difficulty in obtaining tenants.

14. *Q.* (*Mr. Muir-Mackenzie.*)—The population is very sparse?—Yes, and there is no fixity of tenure.

15. *Q.* (*The President.*)—Does he say that himself?—Yes; there being no fixity of tenure, the people are very chary of taking up works that they would get no benefit from. In States which Government supervise we are having a cadastral survey made with a view to having fixity of tenure; we have reduced the rate of interest on *takavi* advances to 6 per cent.

16. *Q.* How much *takavi* did you give?—In the Baoni State, with a revenue of a lakh, we gave Rs. 8,000; that is a Mahomeden State and so we charged no interest.

17. *Q.* How do you get your return?—By enhanced revenue. In Bijawar, with a revenue of two lakhs, we gave Rs. 8,000; we would give more, but we don't know if the tenants could apply it usefully.

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* Not printed.

Captain F. G. Beville.

18. *Q.* For what is it given ?—Wells and plough bullocks and seed grain. A well costs Rs. 60, and in certain tahsils these wells on an average will irrigate 10 acres of lands, and therefore I think it is more economical to have them than tanks.

19. *Q.* The Petwa Canal only works through the *rabi*; there is practically no water available in the months of May and June, so they could not have an early *kharif*; but there is water available for a late *kharif* if the people would sow rice ?—In ordinary years there is not sufficient water in the soil to give you a *rabi* except on certain soils.

20. *Q.* We hoped to find some means of raising rice for which there would be any amount of water towards the middle or end of the rains ?—It has not been the custom in the country; I think it is a matter of custom to a great extent, and then the population has decreased during the last decade for want of fixity of tenure.

21. *Q.* I suppose that is due to famine ?—Yes; the pressure of demand on the people causes them to leave the country. As we settle the States managed by Government, we hope to increase the revenue of the State, and extend cultivation; to give them better terms and fixity of tenure.

22. *Q.* (*Sir Thomas Higham.*)—Had Captain Ewbank any experience before ?—He was in the famine of 1897 in Bundelkhand; he naturally had more experience of the country than an officer who was posted straight away. After the famine of 1897 he was deputed to make these schemes and provide works.

23. *Q.* You don't then want anybody else to prospect for works in Bundelkhand so long as you have that programme ?—I think his works are mostly new works; there are existing tanks, which, with a certain amount of repair, would make good productive works; he did not make schemes for these; he mentions them in his report.

24. *Q.* Would the programme of works that he prepared give full employment in the case of such a famine as you had in 1897 ?—His programme is for 9 per cent. for three months; that is rather short, as the orders of Government are 25 per cent.

25. *Q.* What do the members of the States think of protective works; do they think them good, or would they rather spend the money on something else ?—Irrigation and public works are rather neglected in Bundelkhand, with the exception of Orchha, where the Maharaja takes a personal interest in the matter; not much attention is paid to them; it is a question of educating them; the best way is to find works that will give a return for the money spent; then the people will realize the benefits.

26. *Q.* Are religious scruples any obstacle to irrigation; do you think ?—That is an excuse put forward, but I heard at Orchha that there was no truth in it.

27. *Q.* Has Captain Ewbank entered field embankments in his report ?—He suggested that embankments would be useful.

28. *Q.* He does not say where they should be ?—No; he simply makes a suggestion for holding up water.

29. *Q.* Are there any of these now ?—There are a few in the higher plateaus of Aijgarh and Panna towards Nagode in Baghelkhand.

30. *Q.* Do they go on making them now ?—They repair some embankments every year; what they do is to cut the *bandh*, let out the water, and then repair it.

31. *Q.* Are they making new ones ?—No; there is no extension.

32. *Q.* Were any embankments made during the famine ?—Yes, by relief labour and *takavi* grants.

33. *Q.* In every State ?—No.

34. *Q.* (*Mr. Muir-Mackenzie.*)—They were made by *takavi* grants,—not by relief labour managed by the State ?—No.

35. *Q.* (*Sir Thomas Higham.*)—Grants were given to the owners ?—Yes, and they employed their own tenants.

36. *Q.* That is only a way of advancing relief ?—Yes.

37. *Q.* Did they actually make *bandhs* ?—Sometimes they did.

38. *Q.* Should there be supervision ?—I think there should certainly be some one to supervise the works that are undertaken; if there had been expert advice, there would not have been the mistake that has been made at Orchha.

39. *Q.* The State people would know as much about soil as an Engineer ?—Yes; no doubt in this case the Maharaja knew something of the soils; the reason why people would not take up land below the tank from which the Maharaja made ducts was that the soil there was rather poor; if there had been an expert irrigation officer, then this mistake would have been avoided.

40. *Q.* Would not a Revenue officer know more about the soil than an Engineer ?—Where is the Revenue officer; the Maharaja is his own Revenue officer.

41. *Q.* Are there no natives who know settlement works ?—Every native knows the quality of the soil.

42. *Q.* Do you think Captain Ewbank paid any regard to the soils in his works ?—No; some of the soils are such as natives never irrigate at all.

43. *Q.* (*Mr. Muir-Mackenzie.*)—In what soil are *bunds* ?—Heavy soils for the most part.

44. *Q.* They don't make *bunds* in *mar* soil ?—Sometimes it gives them an increased *rabi*.

45. *Q.* Do they find it useful for bunding water to kill *kans* grass ?—It is useful, but they don't make it for that purpose; they do it for the sake of the increased outturn.

46. *Q.* What relief works had you in the last famine ?—Roads and tanks.

47. *Q.* Are the States badly in want of money for these works ?—A large number are impoverished and would require assistance.

48. *Q.* Would they be prepared to borrow ?—Not until they paid up their present loans; many are in debt on account of the last famine.

49. *Q.* Where did they borrow ?—They borrowed from the Gwalior Durbar at 4 per cent. guaranteed by Government.

50. *Q.* (*Mr. Rajaratna Mudaliar.*)—Are these plans and estimates made by Captain Ewbank for his works ?—There are no plans. As generally understood, the plans prepared give the outline of the work, but there are estimates; it is a rule-of-thumb estimate made, so that any *mistry* could undertake the work.

51. *Q.* Could these works be taken up in the event of famine occurring ?—Unless face walls are put in, the works would be useless, and that requires expert labour.

Colonel D. G. Pitcher.

COLONEL D. G. PITCHER, Director of Land Records and Agriculture, Gwalior Residency.

(*Gwalior, 11th December 1902.*)

Note on Irrigation in Gwalior.

In all three divisions or "Prants," named, respectively, Gwalior, Isagarh, and Malwa, and comprising 6 districts apiece, are to be found the remains of ancient irrigation works in the shape of *bunds*, partly earthen, partly masonry. This is particularly the case with Northern Gwalior where, in 1896 A.D., famine was most severe. In the black soil tracts remains of old works are fewer in number, but are sufficient to show that it was found at some time or other worth while to irrigate such soil. To "Raja Man," who flourished about 500 years ago, is always ascribed the construction of these works. It is certain from remarks by Fry and other travellers that in former times Gwalior was the centre of a higher class of cultivation than is now the case, and stone sugar mills or oil mills scattered all over the country, often grouped in one place in large numbers where neither cane nor oil-pressing is now carried on, evidences some remarkable change of circumstances which may reasonably be ascribed to the existing waste of storm waters as compared to the practice of ancient times. Not only have the districts become arid, but the enormous quantity of surface soil washed off annually carries away with it fertility, leaving to the cultivator the labour of re-creating a fertile seed bed on the subsoil. What appears to be called for in Gwalior is the restoration of humidity to the atmosphere by creating reservoirs and large evaporating surfaces of water, and sites for such works abound.

The principal rivers are the Chambal, Sindh, Parbatti, Koonoo, and Betwa, all of which are crossed at points in their course by reefs of rock, but they have no snow-fed sources, and run so deep in their beds as to be useless to us for canalisation save at enormous cost. The Chambal, Sindh, and Parbatti in turn have been carefully examined both in the time of His late Highness, and again since the famine of 1896. Mr. Armstrong prepared a scheme for the Sindh which would have cost some 10 lakhs and would have yielded no more than 2 per cent. at most on account

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of long lengths of masonry channel taken, of necessity, through barren ravines. The project may at some time be useful as a famine relief work, but it was, after full consideration, deemed wiser to spend that amount of money, if available, in the immediate present, on the construction and restoration of smaller works.

Less important rivers are the Morar, Bainsuli, Sank, Sonkera, Asan, Kuari, Son, Lon, and others, but those named are the only ones likely to yield any irrigation, and they too run very deep in bed except near their sources.

The Morar was bunded at Bahadurpur in 1898, and a channel provided with a head-work has been carried for about six miles. In the rains the channel runs full, and supplies water to several villages lying in its course, filling up a number of large tanks, and protecting 1,060 *bighas* of rice. With an additional fall and extension of the channel, costing, I understand, about Rs. 6,000, it will command 2,000 *bighas*. The cost so far has been Rs. 34,563, largely increased over the first estimate by an accident from flood in the first year of construction.

During the famine several nullahs on the catchment area of the Morar were bunded up, and the result is, with reason, believed to have been a greater flow in the river above the weir after the cessation of the rains; one of the nullahs so closed at a cost of Rs. 3,000 now forms the site of a new village paying Rs. 300 per annum for land formerly under thick, thorny jungle, and in all the nullahs land has been reclaimed. If more works of a similar character were carried out, for which many suitable sites exist, it is believed that the supply of *rabi* irrigation might be greatly increased; automatic shutters would also increase the supply of the *rabi*. As matters stand, unless pumping can be established, the *rabi* supply from Bahadurpur is uncertain beyond a first watering for about 120 *bighas*. In 1899 this work alone saved the rice crops of the villages supplied.

The Bainsuli river joins the Morar several miles below Bahadurpur, and has a larger cold-weather supply from perennial springs. It was bunded in 1897 by a *jagirdar* at his own expense at a cost of about Rs. 15,000 British, but was turned a year or two later by an extraordinary flood; still enough land has been reclaimed from waste since the *bund* was built to return to the *jagirdar* a fair percentage on his expenditure. A scheme has been prepared for taking off at Ekeira by some 10 miles of channels the spring and flood waters near the source of the Bainsuli which, if carried out, will enable the *jagirdar* to restore his work, as the floods will then come in greatly diminished force. The Ekeira scheme will fill up every year,—be the rainfall short or otherwise,—a large number of tanks yielding rice cultivation, and should have a fair cold-weather supply for wheat cultivation since the springs never fail.

There is another site below the junction of the Morar and Bainsuli which would, it is believed, yield good results, but it has yet to be properly prospected.

The Asan river runs deep; there is a vast deal of land near its banks which went waste in the famines of 1868 and 1877, but no practicable scheme has yet been formulated. His Highness last year personally examined the river and selected a site, but further inquiries demonstrated, I understand, unsuitability.

The Kuari runs very deep and runs through some parganas which most need water. It can only be treated by commencing high up near the source where a good site with plenty of land on either bank suitable for irrigation exists, and then working down the stream as suitable sites may be found.

The Sank river presents an admirable site 14 miles above the city of Lashkar from which a preliminary survey affords reasonable grounds for saying that a reservoir might be constructed to afford a two years' supply for that city, and further surveys are now in progress. If that scheme is carried out and the floods from the 70 miles of rocky and hilly catchment area be brought under control, there are several reefs of rock across the lower part of the stream which should afford sites for storage.

The Son is a small river with perennial stream for which His Highness, when on tour, ordered a scheme to be prepared, and I understand that a large area of land is found to be irrigable therefrom.

The Sonrekha has been bunded at Jalalpore, and from it two channels, about two miles each in length, supply in the rains water to tanks met in their course, while wheat is sown in the river-bed so soon as the water falls. It is a very useful work.

This river is again bunded lower down at Susera, and supplies water by a channel for both rice and wheat. Other sites lower down the Sonrekha offer equal advantages.

Across the Lon or Lonari a masonry *bund* has been thrown, diverting the flood water into a large new tank at Lohgarh. It was designed to fill by another channel several large tanks near Salbai, but rock of adamantine hardness was met with, for the cutting of which famine labour was found unequal. The tanks in question had their banks restored and raised, and, without the channel, have still been a decided success, but in a famine year the channel will be a necessity to them and ought to be completed so soon as funds can be allotted.

Another *bund* has lately been constructed near the source of the Lonari at Richera from which several large tanks will be supplied; other good sites exist on this source.

On the Parbattia reef of rock across the river appeared to me to offer an opportunity for forming, if crowned with masonry, a weir sufficient in height to turn flood water into a channel through several miles of good land, and communicating on either side with tanks. As at the time simple earthwork for famine labourers was urgently required in that neighbourhood, I had the channel put in hand. Subsequently a sub-overseer sent by the Irrigation Engineer to examine the depth of the rocky reef reported it to be insufficient, and the weir has not yet been constructed; but the report which was, in my absence, submitted to the Durbar shows that my proposals were misunderstood, and I have hopes that the work may yet, at some further time, be carried out.

At Singoli, in the Neemuch district, a fine masonry dam has been built, as a famine work, across a small local river, by Mr. Judd.

All the works referred to date from or subsequent to 1896.

Tanks or Bunds.

These are of four kinds—

(1) Large storage tanks behind masonry dam, fitted with sluice gates for irrigation of rice during the rains, and wheat and sugarcane during the cold season, any surplus water being left as storage. Examples are the series built, at intervals, across a line of 10 miles of drainage at a cost of about 4 lakhs of rupees, by Sir Michael Filose, from which the palace gardens are supplied. The wells along the line of drainage are always full.

Kheria, a fine work built in masonry by Mr. Harris, formerly State Engineer, and also used for supplementing the palace supply.

Udasa, Dinara, Tongra, Dhakoni, Kadroni are all old time works on a large scale with masonry dams giving both irrigation and storage.

At Sabalgarh city, again, is a masonry dam impounding a large body of water and built by Mr. Armstrong. Some irrigation is carried on from it, but its chief value is as a source of supply to the city and as affording a head of supply to the wells in the country stretching below it. In 1899 when all other wells in the district were at a very low ebb, the wells below the Sabalgarh city tank remained full, as well as those below the Tongra and Kuloli tanks.

(2) Tanks constructed for storage of water behind earthen dams, furnished with masonry escapes and sluices, and utilised for supplying water to rice during the rains, and to wheat and other *rabi* crops after the rains. Such tanks are usually constructed across nullahs, and in the latter below the weir, and apart from the channels leading from the sluices are often constructed subsidiary weirs for catching the overflow from the waste weir; thus forming a series of small reservoirs from which water is taken for *rabi* crops by lift.

Examples of such tanks are to be seen at Dobini, Tongra, Kunwarpura, and other places. Dobini was finished just before the last rains, and is maintaining about 500 *bighas* of *rabi*, but principally from subsidiary weirs, as, on account of the work being barely finished, the sluices had to be opened to allow an exceptional flood of these last rains to pass, and sufficient water for the supply of its three channels was therefore not secured. When full, the tank can supply water for 2,000 *bighas* (1,000 acres). It has cost Rs. 50,000, mostly by famine labour, and when fully worked will return good value.

Tonga was built in 1897-98 at a cost, including channels, of Rs. 42,000, affording great relief at a time when the people of the neighbourhood were in great need of it. In 1898 *bighas* 950 were irrigated; in 1899—a famine year—

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bighas 2,563 were saved; in 1900 *bighas* 1,466 only took water, the season being one of good rain; in 1901 the rainfall was very short, and *bighas* 2,476 were irrigated and saved; in 1902 a sudden and unprecedented flood breached the waste weir, and the water was lost, save in the subsidiary weirs, from which about 500 *bighas* of wheat, etc., are under irrigation, and, in addition, the whole of the tank bed has been cropped for wheat. The weir is now under repair, and if the channels be extended, the area irrigable amounts to 5,000 *bighas*.

(3) Tanks for storage of water and irrigation, during the rains, of rice, the surplus water being run off after the rains, and the exposed bed of the tank cultivated for wheat of which the finest possible crops are thus raised year after year without manure and without any further irrigation. In the famine year of 1896 such tank beds and the exposed beds of rivers and streams gave us in addition to what were raised near wells the only crops realised. Such tanks are found everywhere in black soil as well as in other soils, and it is particularly worthy of notice that examples are fairly numerous of *usar* land being gradually reclaimed inside tanks of this kind, and of *usar* soil of a bad class yielding good crops of rice if amply supplied with water from such a tank. It seems from our experience in Gwalior to be worth while trying whether in Oudh from a tank dug in *usar* soil rice crops could be raised on its banks, water being supplied by lift.

(4) Tanks built for the storage of water throughout the year for supplying man and beast in otherwise waterless tracts. Examples of these are tanks that were built in 1897 and subsequent years at Panwara, Ameit, Agra, Karahal, Khirkhiri, and other places in the Sabalgarh and Sheopore districts. In the Karahal pargana the tanks above named were all fully reconstructed on the sites of ancient works of unknown antiquity. Owing to the destruction of those works the pargana lapsed from a state of prosperity into jungle, and for many years previous to 1897 for some 40 miles water was hardly procurable. In the neighbourhood of Panwara alone are the sites of eighteen deserted villages. A supply has now been established that is pretty evenly distributed over the area affected, but much more remains to be done. It is noticeable that to each of the tanks named can be traced the source of a small river. Such are the Sip and the Suari, both of which run dry now in the hot weather, but are said to have been formerly perennial. It is hoped that the rivers will in time again become perennial. Khirkheri is a very fine work, affording a fine sheet of water; the ruins of the old village prove how large the population must at one time have been.

Wells.

These are, as elsewhere, *kachcha*, *pakka* or *kachcha-pakka*, and may be classed into wells used for drinking purposes only and wells for irrigation.

Without a well for drinking purposes a new hamlet cannot be founded, and new hamlets, as increasing the area of the highest, that is, the manured and irrigated, class of cultivation, stand in the front of agricultural improvements. Even if a hamlet be not founded, outlying tracts of good land often lie unutilised; because the would-be cultivator cannot obtain within a reasonable distance water to slake the thirst of himself and of his cattle during their day's toil. Many wells have been sunk with this object.

As to *kachcha* wells, the factors are a sufficiently stiff soil, and water sufficiently near the surface to suit the strength, for raising it, of the local breed of cattle. Where these factors are all favourable *kachcha* wells are freely sunk by zamindars and tenants alike.

For *pakka* wells also costing from Rs. 200 to Rs. 1,200, according to depth of well, number of pairs of bullocks to be used and consequent width to be given, advances have been given by the State most liberally for the last six years. For five years of that period the Land Records Department advanced direct, and for the last year *sar-subahs* and *subahs* have advanced. There is no difficulty experienced in getting applicants to come forward; the rate of interest is low, being 4 per cent. for the first year, and 6 per cent. for subsequent years. Land irrigated from wells sunk during the course of a settlement is assessed at the settlement next following at dry rates. Well-sinking by private means is on the increase, but much remains to be done, as will be seen from table appended showing *kachcha* and *pakka* wells per square mile of total area in use during the past three years 1899-1900 (famine year), 1900-01, 1901-02. The average all over the State works out to five *bighas* cultivated area per well, which seems very low, but the cattle are small and poorly fed.

A note on irrigation in Malwa drawn out by Mr. C. Judd, Divisional Engineer, is appended.*

Statement showing area and number of pakka *and* kachcha *wells in actual use.*

Serial No.	Name of District	Area in square miles	SAMBAT 1956, 1899-1900.		SAMBAT 1957, 1900 01.		SAMBAT 1958, 1901-02.		REMARKS.
			Pakka or pakka-kachcha.	Kachcha.	Pakka or pakka-kachcha.	Kachcha.	Pakka or pakka-kachcha.	Kachcha.	
1	Bhind	857	1,284 *1·19*	1,560 *1·82*	1,035 *1·20*	398 *·46*	1,074 *1·25*	461 *·53*	
2	Tomarghar	720	1,689 *2·34*	2,153 *2·99*	1,759 *2·44*	1,239 *1·72*	849 *1·17*	911 *1·26*	
3	Boid Gwalior . . .	1,124	3,549 *3·15*	639 *·56*	2,628 *2·33*	212 *·21*	3,125 *2·78*	598 *·53*	
4	Sikarwari	843	2,287 *2·71*	1,493 *1·77*	2,198 *2·60*	751 *·89*	1,980 *2·34*	1,159 *1·37*	
5	Sabalgarh . . .	1,122	1,906 *1·60*	1,725 *1·53*	1,797 *1·60*	1,209 *1·07*	1,841 *1·64*	1,618 *1·44*	
6	Bhandero	513	978 *1·80*	2,262 *4·16*	828 *1·52*	721 *1·32*	939 *1·72*	759 *1·39*	
7	Narwar	1,139	2,330 *2·04*	290 *·25*	2,348 *2·06*	249 *·21*	2,275 *1·99*	454 *·39*	
8	Sheopore	910	255 *·27*	47 *·05*	224 *·23*	93 *·09*	228 *·24*	117 *·12*	
9	Bhilsa . . .	1,400	813 *·58*	859 *·25*	807 *·56*	394 *·28*	601 *·42*	440 *.31*	

Figures in *italics* show the average number of wells per square mile.

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* Not printed.

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Statement showing area and number of pakka *and* kachcha *wells in actual use*—contd.

Serial No.	Name of District.	Area in square miles.	Sambat 1956, 1899-1900.		Sambat 1957, 1900-01.		Sambat 1858, 1901-02.		Remarks.
			Pakka or pakka-kachcha.	Kachcha.	Pakka or pakka-kachcha.	Kachcha.	Pakka or pakka-kachcha.	Kachcha.	
10	Isagarh	1,611	1,573 *·97*	433 *·26*	1,547 *·96*	447 *·27*	1,381 *·85*	546 *·33*	
11	Pitchore	1,780	5,062 *2·84*	3,102 *1·74*	6,710 *3·76*	3,119 *1·75*	5,963 *3·35*	3,426 *1·92*	
12	Bajrangarh . .	1,065	1,782 *1·68*	1,218 *1·15*	1,857 *1·76*	1,181 *1·11*	2,107 *2·09*	2,058 *1·9*	
13	Ujjain	1,505	1,226 *·81*	2,170 *1·44*	1,162 *·77*	1,937 *1·28*	867 *·57*	1,812 *1·20*	
14	Shajapore	2,220	1,344 *·60*	3,900 *1·75*	1,388 *·62*	3,880 *1·74*	1,178 *·53*	3,419 *1·55*	
15	Agar	1,273	2,094 *1·61*	6,407 *5·03*	2,185 *1·71*	6,357 *4·19*	1,715 *1·34*	4,101 *3·22*	
16	Mandasore . . .	728	407 *·55*	3,467 *4·75*	559 *·76*	3,516 *4·84*	421 *·56*	3,680 *5·05*	
17	Neemuch	992	2,438 *2·45*	1,913 *1·92*	3,364 *3·39*	2,629 *2·65*	1,574 *1·58*	2,791 *2·88*	
18	Amjhara	1,301	192 *·13*	556 *·40*	208 *·15*	597 *·45*	195 *·14*	576 *·41*	

Figures in *italics* show the average number of wells per square mile.

1. (*The President.*)—Will you be so kind, Colonel Pitcher, as to read such portion of the Note you have prepared for us?—[Note read.]

2. *Q.* Is there any one part of Gwalior State where the rainfall is heavier and more reliable than another?—No; there is no such place; perhaps the black soil tracts, as a rule, get most, and suffer from rust. The fall is heaviest in the south. The rainfall in the portion of the State north of the Vindhyans in 1896 failed partially and in 1899 completely.

3. *Q.* You have sketched out a very extensive programme of *primâ facie* works; quite enough I suppose, to tax the resources of Gwalior for many years?—Yes.

4. *Q.* You also, I believe, lay great store upon village irrigation works?—Yes.

5. *Q.* You have carried out a great number of these?—They were carried out under general instructions from me.

6. *Q.* When did you begin to carry out these minor irrigation works?—In the beginning of 1897.

7. *Q.* They were a new thing, I suppose?—Yes; from inquiries made I understand that works were formerly carried out most irregularly and unscientifically; enormous arrears of water-rates had to be written off.

8. *Q.* As regards the works begun in 1897, have you been able to see what the result has been?—Very beneficial; the general effect is that the revenue in those tracts in which most money was spent on irrigation has since been paid with the greatest regularity.

9. *Q.* Has any new land been brought under cultivation?—Famine came in 1896, and 1897 was a fairly good year; in 1898 we made a summary settlement. The average collections of three good years before the famine year were 40,18,000 British rupees; then we began irrigation, and a *jama* was fixed at the re-settlement in 1898 of Rs. 50,66,000; including the arrears of the famine year in which suspensions were made, collections for 1901 and 1902 averaged 55 lakhs of rupees per annum.

10. *Q.* Do you think the greater part of that increase may be fairly ascribed to these 200 tanks you built?—No; two effects were observed: in the first place, revenue has been paid with far greater ease than before; and, again, those districts in which most money has been spent are the districts that pay with greater completeness and punctuality.

11. *Q.* Are these minor tanks not generally supplied with sluices?—I think they are; there are two kinds of tanks: those in which water is let out and the bed cultivated, and those in which the water is retained.

12. *Q.* In spite of running the water off, is there any appreciable addition in the raising of the spring level of wells?—Yes, of course; I have not made detailed experiments. The wells below a tank in Sabalgarh City gave a good supply when other wells in the district failed.

13. *Q.* As your experience in regard to these minor tanks is of the highest value, we shall be grateful if you will jot down a few facts which have come under your personal observation. Have you had any opportunity of seeing a deposit of silt formed in these little tanks?—Yes. I know of ravines in which the land was previously uncultivable and useless, and in which by the introduction of silt the land has been made to yield Rs. 200 to Rs. 300, but the policy is to take no revenue on improvements until the next settlement of the land revenue.

14. *Q.* Have you been able to form any estimate of the cost of reclaiming an acre of land in this way?—No.

15. *Q.* Do you think, from your general experience, there is reason to believe that by extending the system of minor irrigation there has been material improvement made in the matter of checking denudation?—Yes.

16. *Q.* At no extravagant price?—Certainly.

17. *Q.* (*The President.*)—I think in the *mar* land to the south of Gwalior there are remains of many old tanks?—There are some old tanks there, but not so many as in the other soils. As far as I can learn, it was in 1720 or 1750 that Ragonath Rao Peshwa marched up towards Gwalior; from that time constant warfare commenced and the country suffered greatly, while many of the tanks fell into disuse.

18. *Q.* Did climatic change follow the destruction of the tanks?—Yes.

19. *Q.* I suppose it is contemplated to restore a number of these tanks?—Yes. I believe His Highness is favourably inclined towards restoring them. Last year he went out on tour personally, visited many villages alone, and selected sites for wells and tanks, and distributed about Rs. 50,000 for that purpose; but I may mention that our great difficulty here has been, and will be, the want of competent

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subordinates. In the famine of 1896, directly I got charge as central officer for famine relief, I wrote to the Public Works Departments and the Chief Engineers of the United Provinces and of the Punjab asking their assistance, but was told that I could not have a single man. As to the sub-overseers, we had to take the leavings and cast-offs of the provinces, some of whom had gone through very curious experiences, which were not very satisfactory.

20. *Q.* (*Mr. Muir-Mackenzie.*)—I understand that His Highness is thinking of starting an Engineering College here?—Yes. There is one thing also about Roorkee training; that is, it has no application to Gwalior. Beyond teaching arithmetic, levelling, and surveying, the instruction has no application to the conditions of the country and to the small works and large works needed in Gwalior. The men must come here and have a local training.

21. *Q.* (*The President.*)—I should think it might be a good thing if you were to send up a few Gwalior lads for partial training in these preliminary subjects, perhaps at Roorkee, and then let them come down here. Roorkee would have to take them in on the understanding that they were not available for general service, but for the Gwalior State?—That might work.

22. *Q.* Have you got a personal experience of Bundelkhand?—Only in marching tours. I have marched all over Bundelkhand.

23. *Q.* I suppose the Agency and Lalitpur are similar?—Hamirpur and Banda are more like the country down towards Bilsa, all black soil, though some parts of Banda resemble the districts nearer Gwalior.

24. *Q.* And Jalaun?—Is more like Bilsa; it is nearly all black soil plains.

25. *Q.* As regards Lalitpur and Jhansi, do you believe there that the system of making tanks would be useful?—I am sure it will. When I was there I had a great deal of conversation with Major Bellasis, the Executive Engineer, who was very much set on building tanks. He was not always successful in his tanks, because he went there without experience, but his ideas were right as to the advantages of tanks.

26. (*Sir Thomas Higham.*)—The difficulty is whether they can get good sites there. The soil is not good to irrigate?—Then comes in my idea about evaporating sites. The tank you saw the other day is so far of no use for irrigation. It is still a useful reservoir, which, if the State has money, it should build in numbers for evaporating purposes for the general benefit of the climate of the country.

27. *Q.* Whether land is irrigated or not?—Yes.

28. *Q.* Of course the benefit will be enormously increased if you had land to irrigate?—Of course it would be, but I would not confine the idea of benefit simply to irrigation. If you have only a small amount of money to spend, for which you must have a return, that is a different thing, but where money is plentiful it will be most beneficial to increase these reservoirs as far as your funds will allow.

29. *Q.* Anyhow, they will improve the well irrigation probably?—Undoubtedly.

30. *Q.* Have you decided how far the spring level of a well is affected by that?—I have not decided.

31. *Q.* I suppose there is a good deal of well irrigation in Gwalior?—A fair amount; it is increasing very rapidly. In addition to the works that are mentioned in the list I gave you, two lakhs and odd under my direction have been given in advances. In the famine I spent a good deal, and then I got Rs. 50,000 a year from the Board of Revenue for distribution; since I went home on leave two years ago His Highness has given this money to the Commissioners and Collectors to distribute. I have got a list of the amounts so distributed last year.

32. *Q.* What does it come to about?—In one division Rs. 63,235 and Rs. 40,617 in the other. One division had Rs. 1,32,000 and the other Rs. 1,36,000 placed at its disposal for advances, and the *subahs* are now out in camp personally inspecting sites and giving advances for wells and tanks. The interest is either Rs 4 per cent. or 6 per cent. according to the period for which the loan is taken, and I think they will repay the money by next settlement.

33. *Q.* You mention in your note some deep nullahs across which you propose to put a *bund* high up near the sources to get water out on the land?—No; to check the water and keep it there, and let it soak in. It is not to irrigate, but to let it soak in.

34. *Q.* I understand you proposed a *bund* high up the nullah?—That refers to the river Morar, and the nullahs go in all directions, and there are a number of them. What we did in the famine was to bund them up at the mouth; the water very soon subsided into the subsoil, and when it subsided the area has been cultivated behind the *bund.* I looked to these for supplying the spring sources of Bahadurpur down below.

35. *Q.* Would you go down below?—I don't propose to go much further, about seven miles. The back-water at Bahadurpur leads back 1½ to 2 miles.

36. *Q.* What did you do at Bahadurpur?—We have got a weir across the river.

37. *Q.* Could you get this water on to the country?—Yes, throughout the rains it goes out six miles into big tanks, and fills them.

38. *Q.* I understood from your note that in cases like this you propose to also make *bunds* across the nullahs?—Across the feeder nullahs; not across the main nullahs.

39. *Q.* How will all these nullahs affect the Morar?—I want to stop every one of these to regulate the floods.

40. *Q.* Then it is no use making *bunds* lower down?—I cannot say. It will be a long time before we get there. It is only a general idea I express here. The only way to try that is to begin high up and gradually work down as you find it practicable.

41. *Q.* You say if you make these great tanks, they will always be of benefit on account of the wells?—Yes, and the surface afforded for evaporation.

42. *Q.* That is a separate thing. In regard to wells, take that tank we went to see the other day; that would only benefit wells round a very narrow fringe?—It would benefit down stream.

43. *Q.* How many miles?—Only about seven or eight miles to Pichore.

44. *Q.* The total area of irrigation that you benefit from a tank like that must be very small?—It is not large.

45. *Q.* Then you must rely on the value of your evaporation, but one thing about the evaporation is that it is intangible. You can never measure what good it is doing?—I am afraid I can give you nothing tangible, not even about wells, as we have no figures.

46. *Q.* (*Mr. Muir-Mackenzie.*)—What is your theory about the wells? Do you benefit a certain number of wells on either side of the stream?—My theory is that by bunding small rivers and streams you increase the water in the wells in the country on either side of the channel below the *bund.* It is a known fact, however, that with deep rivers like the Ganges, near the banks the wells are deepest you could find anywhere, and I don't think that has ever been explained.

47. *Q.* But as regards the tanks with small streams running through them? In the Deccan we found wells are all deep close to the main nullas, and what I wanted to know is whether your understanding of this aid to wells is that it increases the supply of water in the bottoms of the wells fully near the main nullah?—Yes, when such wells are below the *bund.* Mr. Judd states that in the Singoli district the majority of wells this year are very low or dry, but below Dhanjoun Tank, which was made in 1900, all wells are full for a distance of three miles in the valley. May I also read this note in which I say that in Pargana Karahal, which is about 1,700 feet above the sea, there is a tract of about 40 miles of waterless tableland. Round about one ruined tank lie eighteen villages depopulated through the want of water for the cattle and people to drink. We found remains of old tanks all along there, and the people say that when those tanks were kept filled the population was pretty large.

48. *Q.* Is the soil pretty good?—Yes. At the head of each of the rivers flowing during the rains from this tableland was found the ruins of a large tank. I have had the tanks restored and kept filled, and the people all assert that the rivers now run for a longer period instead of drying up soon after the rains.

49. *Q.* What has the effect of this been?—A more regular supply in these rivers, and the spring supply in the rivers below is now more than it was before we restored these tanks.

50. *Q.* Have the people come back?—They are beginning to come back.

51. *Q.* Do you suppose these tanks were formerly used for irrigation, or simply for holding up the water?—Probably for holding up the water. Vast herds of cattle

graze in those forests, and in the hot weather they leave the forests because there is no water. Now we are giving them water they are coming back. In the Rajputana famine we had herds of cattle and crowds of people come over to our forests wherever we had tanks.

52. *Q.* (*Sir Thomas Higham.*)—I understand that in the case of all these protective works that were made during the famine no charge has been made for the benefits that have been received; no water-rate has been put on because of them?—No.

53. *Q.* That will remain until the next settlement, I suppose?—That depends on His Highness. We have had one settlement since the famine, and we have taken the benefit of our works up to that settlement.

54. *Q.* You gave us some figures just now showing the increase of revenue as compared with the years before the famine. Is that due to the additional revenue taken on that settlement?—Not entirely. It is partly due to that, but I cannot say precisely. What I claim as very largely due to it is the regularity with which the revenue has since been paid.

55. *Q.* That is to say, you have given fewer remissions?—We have given no remissions since then. In 1899 we suspended revenue, but did not remit, and have since collected such suspensions.

56. *Q.* The increase of revenue has not been due to a water-rate?—No.

57. *Q.* There has been a partial enhancement of the assessment made at the settlement of 1898?—Yes.

58. *Q.* And you think that these works, taking them altogether, will be directly remunerative in the increase of revenue derived from them?—Undoubtedly.

59. *Q.* You think the money spent a good financial investment?—Undoubtedly.

60. *Q.* Apart from the saving of expenditure on famine relief?—Yes; I think that at next settlement the revenue will be increased through the medium of these works considerably to what it would have been had these works not been constructed.

61. *Q.* (*The President.*)—It would pay, would it not, to have these works done by contract?—That was the case in the time of Doulat Rao Scindia, when the revenues of the districts were farmed out to contractors who keep these works in repair, and it was found that it paid the contractors. You have heard of the millionaire Seths of Muttra; they were contractors of revenue under Gwalior, and walked away with crores of rupees?

62. *Q.* This statement shows the population, gross area cultivated, and what you can protect by irrigation?—Yes, in a year of drought.

63. *Q.* Has this area been very considerably affected by the works constructed?—These figures have only been systematically collected of late years.

64. *Q.* Do you think you could protect a much larger area now than you could in 1896?—Yes. I am quite sure that a larger area is now protected than in 1896.

65. *Q.* The expenditure on protective works amounted to about Rs. 2,00,000?—About that; Rs. 2,80,000 is the amount.

66. *Q.* These were the works constructed during the famine time?—Yes.

67. *Q.* And in respect to that expenditure do you suppose the area has been very greatly increased that has been protected?—Not in proportion. It was done by famine labour and was expensive; the same amount spent in an ordinary year will probably give you double this number of works. But so far as these works went, there was protection.

68. *Q.* You have not told us anything about field embankments in black soil. Do you do much of this here?—On fields in a sloping country they raise these *bunds*, which you call embankments, and check the flow water.

69. *Q.* What part do they do that in?—In black soils; where there is no irrigation from wells, you find these embankments.

70. *Q.* Were any embankments of that sort made as relief works?—Yes, where there was a favourable slope.

71. *Q.* Do people make them by themselves?—Yes, they have taken advances for that too.

72. *Q.* In regard to wells did they run dry in the famine?—Yes, very largely.

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73. *Q.* Was there much cohesion of the wells?—Yes, very great.

74. *Q.* Did you find in any case that they were able to replenish the supply by boring down through the rock underground?—We have tried getting through the rock, but there are few cases in which we have been successful so far.

75. *Q.* Do you know any cases in which there has been a spring up from beneath the rock?—I cannot cite a case. Mr. Taylor might be able to do so, but I don't remember a case.

76. *Q.* (*Mr. Muir-Mackenzie.*)—As regards this irrigated area from all sources given in your statement, does that mean from wells?—Wells and tanks.

77. *Q.* We are not able to differentiate what come from tanks?—You can for this last year, 1901-02. I am beginning to differentiate it now, and you will find that this return gives the irrigation figures within the year. I have great trouble in getting this correct, but in another two or three years I hope to get it really accurate.

78. *Q.* One thing that we observed in the United Provinces, for instance, was that in the famine year 1896-97 the area under tank irrigation decreased enormously, because the tanks did not hold water, and the area under well irrigation increased enormously?—Their tanks are so different to ours. The tank in the United Provinces is all irrigation from lifts.

79. *Q.* The greater part of this irrigation of yours is in the bed of the tank?—Yes.

80. *Q.* Behind the *bund*?—Yes. The average for tanks all through was 21·65 *bighas* below the *bund* and 31 above—a ratio of 3 to 2.

81. *Q.* Was that 31 *bighas* generally uncultivated before?—Yes, before that they were sown for a *kharif* crop but not a *rabi* crop.

82. *Q.* There is another point in these figures which I don't understand. For the Malwa Branch I observe in the normal year you have very nearly double as much as in the year of drought. What is the difference due to?—It is probably from wells.

83. *Q.* The nullahs failed?—Yes.

84. *Q.* On the other hand, in Gwalior, I see the area rose. There is a great deal more well cultivation in Malwa than in Gwalior?—The reason of sinkage in Malwa was that in the dry year of 1899-00 there was a failure of wells. Seventy-five per cent. of the wells ran dry in Malwa. The water-level only reached its proper level this year.

85. *Q.* Malwa was affected by the 1899-1900 famine?—Yes.

86. *Q.* Gwalior was not?—It was affected, but not so severely as Malwa. You were asking me about the boring of wells just now. Mr. Judd has given me a note in which he says "deepening wells where trap rock is found was a failure, unless great depth be taken. The average of wells is 10 to 50 feet. One well, 60 feet, was deepened to 110, and then a fault in the rock was reached, and the water rose 25 feet in the well." That was one successful case, and I know one at Sehore in trap rock which was also successful.

87. *Q.* Have *takavi* advances been given in the Gwalior State under your supervision and orders?—Yes.

88. *Q.* What is the exact method which you pursue in the giving of them? Does a man come in to you for the money, or do you send it to him?—The men came to me with their applications, and I made inquiries through my *kanungos* in the village, if I thought it was necessary, and then gave him the money.

89. *Q.* Is the fact of his having to come in a long distance a great deterrent?—No.

90. *Q.* It is urged in British territory that it is a great deterrent?—I believe not. I was in Hardoi nearly a year and a half, and the year after my arrival I gave Rs. 50,000 in that district alone as *takavi*, and they all came to me and got it. I could not give as much as I had applications for.

91. *Q.* Did they come to you in camp?—To the Cutchery principally.

92. *Q.* That is to say, at head-quarters?—Yes. After I left, my successor instituted inquisitorial rules, and the people would not come in for *takavi*, and Government inquired why the *takavi* advances had decreased when I left.

93. *Q.* Of course it might be urged that the reason why the people took the advances was that they were able to

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misappropriate them to purposes other than that for which they were given. Do you believe much misappropriation did take place?—No doubt, it did to a certain extent.

94. *Q.* To a large extent, do you think?—No.

95. *Q.* Do you think that, if without too close an inquiry you gave a man money for a well, you might be confident that a greater part of that money would be spent on the well?—That is difficult to answer precisely, but I was confident that every advance I gave would be recovered.

96. *Q.* You deprecate too much inspection?—Too inquisitorial inspection, because it means that the men you send to make these inquiries will take their percentages.

97. *Q.* What period is allowed for repayment of *takavi* in Gwalior?—Various terms. I think it is now three or four years. In the famine time we gave six years. His Highness has been very liberal this year in giving advances to *subahs* and *sar-subahs*, and they have to go on their tours and see on the spot who wants the money and give it to them themselves.

98. *Q.* The people are quite content to pay back in four years. They don't find the period too short?—No, they take it very readily.

99. *Q.* What sort of security do you take?—I think we take nothing except their land.

100. *Q.* Then it is always to zamindars that you advance?—I have always advanced to zamindars.

(*His Highness the Maharaja.*)—There used to be a lot of trouble about this formerly, so now I have ordered the Collectors to judge from the character of the person and his property, and if they are satisfied that he is a proper person, to give him the money on the spot.

101. *Q.* (*Mr. Rajaratna Mudaliar.*)—Do you give any remissions when wells fail?—Where we have built them we don't charge at all.

102. *Q.* But where you have advanced *takavi*?—They don't get remissions; they must take the responsibility.

103. *Q.* (*Mr. Muir-Mackenzie.*)—You were in charge of the famine relief works in 1896-97?—Yes.

104. *Q.* Did you manage to employ a greater part of your labour on irrigation works?—No.

105. *Q.* How large a proportion?—You have it all in this famine report. The average of labourers per day on these works were 1,297.

106. *Q.* Did you manage to get irrigation works for one-fourth the number, or one-third the number?—I could not tell you without studying the figures again; the figures are to be found in this report.

107. *Q.* Have you got a programme of future works?—Yes

108. *Q.* What proportion is irrigation?—They are all irrigation. The programme for famine relief is entirely irrigation works.

109. *Q.* Does that mean in your real famine you hope to employ everyone in irrigation works?—We will employ them on that as far as we can in preference to any other work.

110. *Q.* Do you believe you could find employment for them?—I don't doubt it, if I can get the money.

111. *Q.* You could find irrigation works to employ them?—Yes. I believe there is scope for employing the people, and near their villages too. In 1877-78 I gave the opinion that in Oudh the people should be employed near their villages on tanks.

112. *Q.* For irrigation as apart from drinking water-supply?—No; the two together. As a tank is useful, whether for irrigation or for water-supply, or as affording evaporating surface, the more you can get the better for the country.

113. *Q.* You say you would employ the greater number of them on tanks or some sort?—I think the greater part would be for what we call irrigation here.

114. *Q.* Either for irrigation behind the *bund* or below the *bund*?—Yes, and for embankments.

115. *Q.* I wanted to ask you one or two questions about Oudh. You served there a great deal?—Yes.

116. *Q.* You made some very special inquiries, did not you, after the famine of 1878?—Yes, as to the rates of mortality.

117. *Q.* Your inquiries were in Rohilkhand?—Yes.

118. *Q.* You found there had been very considerable mortality there?—Yes. The question was whether the mortality was correctly reported or not. The Famine Commission took the United Provinces Government to task for the mortality and assumed that the recorded figures were 25 per cent. below the actual figures. Government did me the honour of asking my views upon this, and I said that was a wrong assumption to make before you were certain that the reporting was correct, and that the only way of arriving at it was to divide the worst villages into circles and make a house-to-house inquiry in these villages. Government thereupon said "you are to do it," and I had to do it for Rohilkhand. I found just the opposite, and that it was reported 25 per cent. over what the actual figures should have been, and that everything was put down to famine, because there was a great outcry about the reporting, and the *chaukidars* reported every death they could as due to famine.

119. *Q.* Allowing for all this exaggeration, the mortality was severe?—Unquestionably; but there were no grounds for exaggerating.

120. *Q.* The only point or question is whether you consider that Rohilkhand might again be exposed under certain circumstances to famine?—Undoubtedly. I happened this morning to find my diary of 1878, and there I found that a canal from the Ganges was formerly proposed going through the Bijnor district. In fact, the people pointed out where the pegs had been laid down for it. Everywhere, where the place was through which the canal was to pass, they eagerly inquired and they begged that I should use my influence towards bringing the canal into their district.

121. *Q.* (*Sir Thomas Higham.*)—Their ideas were influenced a good deal, were they not, by what they had gone through?—Yes; they pointed out the prosperity of the villages on the other side of the river, and asked when we were going to benefit them in the same way by bringing a canal into their district.

122. *Q.* Did the owners say the same thing?—These were the small zamindars and cultivators. I don't suppose the taluqdars would have said the same thing.

123. *Q.* (*Mr. Muir-Mackenzie.*)—You were also on the Provincial Committee which inquired into the famine?—I was Secretary to the Local Famine Commission.

124. *Q.* Did that Commission advocate any irrigation works in Oudh?—I don't remember its doing so. I personally advocated the digging of tanks as the best form of famine labour in the neighbourhood of villages in Oudh.

125. *Q.* Did you advocate the Sardah Canal?—I cannot say. As Secretary I had to compile all the replies received from all officers in all districts. If there is anything, you will find it in these printed replies.

126. *Q.* Have you any strong opinion about the Sardah Canal?—Very strong. I was in Lucknow when the Sardah Canal was started, and Colonel Forbes and his office assembled there in the year 1870, and I had many talks on the subject with him and with his assistants, Mr. Hancock and Colonel Clibborn.

127. *Q.* What is your view about it?—My view always was that the Sardah Canal should have been constructed on a less ambitious scale than was first proposed; that is to say, it should have been constructed not as a navigating canal, but as an irrigating canal only. It should have been carried out in the way proposed subsequently by Captain Clibborn in an amended scheme, which was to take the canal into parts where it was required and not into those parts already fully furnished with wells. I think that plan is the only one on which the Sardah Canal could have been successfully constructed, and that it could have saved the country from famine in 1877 and also in 1896.

128. *Q.* (*The President.*)—Was there much misery in Oudh in 1877?—Yes.

129. *Q.* Did you find at that time that the taluqdars were actively opposed to the canal?—I found that the taluqdars were the only people who had a voice in the matter. They were led by a taluqdar through whose estates the canal would have run; and although I cannot guarantee the correctness of it, the general rumour then was that the zamindars in those villages were sub-proprietors, and would become too wealthy and powerful by the opening of the canal for his views.

130. *Q.* Used apprehensions never to be expressed as to the water-logging of the country?—I don't remember any apprehension as to water-logging. Apprehensions were expressed, to the best of my recollection, that the Gogra would cover the land with silt, and that the fertility of the soil would be destroyed by a coating of sand.

131. *Q.* The spring level in Oudh is generally high; is it not?—No. It varies very much in some districts.

132. *Q.* Would you not personally be afraid of waterlogging it the canal was built?—Not if it were properly aligned and you had drainage when necessary. When I was in Lucknow I had charge of an estate which was under the Court of Wards. I commenced digging wells there and I found they went down to 80 feet deep, and that the Sardah Canal was going exactly along the line where I had constructed two wells. I stopped the rest, and never constructed them. Then when I went to Hardoi I again found the Sardah Canal went along the tract where they wanted most water.

133. *Q.* (*Mr. Roberts.*)—How long is it since you have left Oudh?—12 years.

134. *Q.* Have you seen Mr King's report on the Sardah Canal drawn up during Sir Antony MacDonnell's time?—No, I have not seen that.

135. *Q.* You have not seen the proposal by Sir James LaTouche about a modified canal for Hardoi alone?—No.

136. *Q.* There is a proposal there that a canal, merely as a protective work, should be considered with a view to supplying water to the tanks in years of deficient rainfall. Do you think that would be a good thing?—From what river will this canal come?

137. *Q.* From Sardah?—It would not only benefit Hardoi, but would *apparently* benefit parts of Shahjehanpur where mortality was very heavy in 1877.

138. *Q.* Then about the opinion of the people which is a factor in the case; we have examined a good many taluqdars at Lucknow on this subject. They had all come prepared for this question about the Sardah Canal, and they gave a great many reasons against it. One reason was that it would raise the water-level?—The water-level wants raising in Oudh in many years.

139. *Q.* The report of the Engineer, Mr. King, is that the water-level is high enough and should not be raised?—I happened to find a tour report of mine of 1882-83, and there I find the water-level had fallen to an extraordinary extent in many places, and the people were working hard at the wells, often without bullocks, could not get enough water. Fortunately there was ample late winter rain and the crops were saved; otherwise there would have been a failure of the *rabi*, and we should have had severe distress.

140. *Q.* (*Mr. Muir-Mackenzie.*)—Did the *rabi* fail in 1877-78?—No, I think it was only the *kharif* that failed.

141. *Q.* (*Mr. Roberts.*)—You gave us one reason why the taluqdars should be opposed to it, and that was because of the sub-proprietors. But there is a very large area not under sub-proprietors, and from those tenants they would get an enhanced rent?—Precisely; but you know that from the time of Man Singh and the Tenancy Acts a feeling of enmity has existed between the sub-proprietors and the taluqdars.

142. *Q.* And your idea is that they are not willing that the sub-proprietors should benefit, though they benefit themselves?—I believe they are influenced by the feeling that the sub-proprietor's position would be so greatly increased as to make him a more powerful enemy than he is now.

143. *Q.* Mr. Butler also laid great stress on the fact that wells are increasing rapidly—so rapidly that the ground for reporting that the canal should bring water is less than it was before, and he gave us figures which showed that in Rai Bareilly, Bara Banki, and Pertabgarh the number of wells had enormously increased.

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144. *Q.* You said you gave Rs. 50,000 as *takavi* in Hardoi in one year. Which kind of *takavi* was it?—For bullocks and for wells, because the wells are of no use without bullocks.

145. *Q.* Have you any idea what a well costs?—Rs. 300 to Rs. 400 according to the depth of water and according to the number of bullocks used.

146. *Q.* To whom did you give the advances for wells, as a rule?—To the zamindars. There is no difficulty about security with them.

147. *Q.* Yes, because you have his land. But how did you manage about advances to tenants?—I only gave an advance to a tenant on the security of the zamindar.

148. *Q.* If a zamindar refused, a tenant could not get an advance?—No.

149. *Q.* In your opinion there is no practicable way of giving *takavi* largely to tenants unless the zamindars join?—I have no doubt of that. The fertility of soil is inexhaustible if treated in a proper way. The fertility of soil is similar to coal in a coal mine. The owner of a coal mine allows persons to come in and dig for coal. If they take it with a shovel, they pay a royalty per ton; and if they put in costly machinery, they pay the same royalty per ton, but as the output is greater they have to pay a larger sum as royalty. It is the same in the case of the zamindar and his tenants. The zamindar stands in the position of the owner of a coal mine, and if his tenants by making improvements get an increased crop, the zamindar has a right to share in the increased outturn, and the tenant should not be allowed to appropriate the whole of that increased fertility to himself.

150. *Q.* From that point of view you see no injustice where a tenant has dug a well that he should pay wet rates for land irrigated from that well?—Certainly not. I may say it is the opinion in this State, and it is acted upon, that any tenant now can sink a well, although his zamindar is opposed to it, but that he shall pay an increased rate according to the irrigated rates in the neighbourhood, if he does it without coming to some private and previous agreement with the zamindar.

151. *Q.* One objection to our present system of giving *takavi* is that a great deal is exacted by underlings. Do you think that amounts to any very large percentage of the sum advanced?—It used to, but I don't know what it does now. Soon after going to Lucknow I got a tahsildar in the treasury run in and convicted for taking 5 per cent. as commission on *takavi* advances.

152. *Q.* Is there any practicable way of preventing that?—The only way is by seeing it given yourself.

153. *Q.* But the people themselves are in such a way that they will pay?—Yes, unless the people show more independent spirit and complain, and unless you listen to their complaints, you cannot prevent this.

154. *Q.* But they won't complain of small exactions?—No.

155. *Q.* The rate of interest for *takavi* is 6¼ per cent. Do you think that rate is too high?—Well, the argument generally is that Government can borrow money at 3½ per cent., but you must leave some margin for tenants dying and bolting, and losses of that kind. I think 6¼ is as low as it reasonably can be put.

156. *Q.* The rate of interest, then, is not a deterrent at all?—No. It is not excessive.

157. *Q.* (*Mr. Rajaratna Mudaliar.*)—Would you recommend its reduction to 5 per cent. as in other provinces?—In Oudh I should leave it as it is; I don't think that the present rate is deterrent.

MR. K. B. **JADHAVA**, Subah of Baroda.

(*Gwalior, 11th December 1902*)

Mr. K. B. Jadhava.

1. *Q.* (*The President.*)—What is the position you occupy in the Baroda State?—I am a Subah.

2. *Q.* In your paper on Baroda you say in paragraph 4 "the water under the black cotton soil in Amreli is saltish, and the land, if irrigated constantly, would refuse to grow any crops. Notwithstanding this, wheat and *kamod* rice are grown under well irrigation" Is there much rice grown under wells?—Yes; when water is within 30 feet, it pays.

3. *Q.* I suppose it is a very good description of rice?—Yes.

4. *Q.* Then you go on to say in the same paragraph, "sugarcane used to be grown, but Government had to check it by a special impost of Rs. 12 per *bigha* (Rs. 2,074 per acre), as it requires irrigation throughout the year and the salt water spoils the land." Are these wells salt in their nature?—Yes, the wells are usually not more than 30 feet deep in the black soil tracts.

5. *Q.* Then you speak of Navsari black soil; do you want much irrigation there?—Yes, on account of the *rabi* crops.

6. *Q.* Has there been any attempt in the Baroda State to make irrigation canals?—Yes.

7. *Q.* From where?—From the Orsang river. Our original idea was to bund up the Heran river and make a big lake of 18 square miles, costing 18 lakhs, in Chota Oodeypore. And if more water was found necessary, I thought of having a canal from the Nerbudda and join it to the Heran,

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and carry this canal to join the Orsang Canal somewhere near Bhadarpur. If we can succeed to secure the site on the Nerbudda, it would of course be unnecessary to make the big lake in the Heran. Levels have been taken for some distance, and I have walked a certain distance towards the Nerbudda; from the trigonometrical map I can show that it is possible to connect the Nerbudda with this scheme. A weir has already been built on the Orsang at Jojawa near Bhadarpur Railway Station. (This was all said looking over maps and plans.)

8. *Q.* Would you take your canal past Dabhoi?—Yes. That is on the edge of the black soil tract; we want to grow better cotton, or other crops if it is not possible to grow better cotton.

9. *Q.* With irrigation?—Yes.

10. *Q.* Are you going to face this question of irrigating black soil?—Yes, Baroda black soil.

11. *Q.* (*Mr. Rajaratna Mudaliar.*)—Is there well irrigation there?—Where wells can be made at a depth not exceeding 50 and 60 feet.

12. *Q.* (*The President.*)—You say in paragraph 18: "there are practically no private irrigation works other than wells, unless a few small tanks may be called so?"—Yes, they have been neglected, but now we are making a systematic survey of tanks.

13. *Q.* Is the State going to pay for the repair of the tanks?—Yes, all works are done by the State.

14. *Q.* And the maintenance afterwards?—If they are small, the Revenue Department will look after them; if big, then the Public Works Department.

15. *Q.* How many tanks will come before you in that way?—I think there will be several hundreds.

16. *Q.* Is there any feeling against irrigating black soil?—No.

17. *Q* There is a feeling in the rest of India?—Our black soil and that of Broach is really *besar*; before 1860 much cotton was not grown; we class this as *besar*, which means black soil mixed with fine sand in some quantity; if it was really black soil only, it would crack; and if people found it unsuited for irrigation, they would not lift water 60 feet and grow onions and sugarcane on it.

18. *Q.* In some black soil they could not make wells at all?—No; the cost would be too great.

19. *Q.* (*Mr. Muir-Mackenzie.*)—The area actually irrigated in the Baroda district is, I see, exceedingly minute; 10 lakhs of acres were under crops, and the area actually irrigated was 28,000?—The cause is that where wells go beyond 60 feet people do not care to work them. The Baroda district has to be divided into three parts: (1) north-eastern strip, called *chorasi*, consisting of Savali and Vaghodia, part of Baroda and Dabhoi, where rice is grown in black soil; (2) north-western strip of Gorat soil, where there are a large number of wells, and where *bagait* or garden crops can be sown; and (3) the southern strip of black soil where cotton is grown.

20. *Q.* (*The President.*)—Until you get a correct survey of the country, can you give any opinion as to the Orsang project?—We are sure the project will be successful at very moderate expense.

21. *Q.* (*Sir Thomas Higham.*)—You have no large irrigation works in black soil?—No.

22. *Q* What is ordinarily cultivated in black soil?—The staple is cotton to the extent of 45 per cent.

23. *Q.* If you make your big canal, do you suppose water will be taken for cotton?—No, it is not necessary that cotton should be watered; it can grow with less than 4 inches of rain. In the Chorand taluka, which adjoins Amod, in 1899 there were only 2·95 inches of rain, and yet the cotton crop was good where the people did not destroy their crops.

24. *Q.* (*Mr. Muir-Mackenzie.*)—What do you mean by people destroying their crops?—People were afraid Government would take a full assessment, and so they allowed their cattle to roam about over the crops, as they did in the neighbouring British district of Broach.

25. *Q.* (*Sir Thomas Higham.*)—Supposing you bring a canal into this district, will the people give up cotton and take to rice?—It is not necessary; they can grow sugarcane, onions, garlic, and other garden crops.

26. *Q.* But the area will be very limited?—No; as it is, cotton is not grown over 45 per cent. of the area.

27. *Q.* What is grown on the rest?—*Juar.*

28. *Q.* Do you mean that if you brought in a canal, *juar* would be replaced by high class crops?—Yes.

29. *Q.* And cotton would remain as it is?—Yes.

30. *Q.* You do not think they would go in for rice?—I do not think so.

31. *Q.* Although it is a good crop and costs less, they won't go in for it. Would rice be more profitable than cotton?—I don't think so, because rice is not a paying crop; it is not exported on a large scale; cotton is the crop of export, and commands a better price than rice.

32. *Q.* If you irrigate that soil and grow high class crops, will there be any difficulty about manure?—There will be difficulty about manure, but I think the State will introduce artificial manure.

33. *Q.* They will have to pay for it?—They pay now in Poona something like Rs. 200 per *bigha* for castor cake.

34. *Q.* What is the manure that will be introduced?—There is an Agricultural Department; we shall find out from it which is the best manure.

35. *Q.* Referring to Appendix 7, column 3, in this statement regarding Baroda, are these actuals?—No, they are estimated areas.

36. *Q.* What is the basis of the estimate?—The quantity of water available in each tank.

37. *Q.* Do you allow so much per million cubic feet?—No; for rice there are three or four full waterings of six inches each.

38. *Q.* Are these all supposed to be rice areas?—Not all; certain are.

39. *Q.* How do you estimate the supply in your project?—From the catchment area.

40. *Q.* You have not the area of what you get in the hot weather?—No.

41. *Q.* Do these ever run dry?—These tanks are not supposed to have water in the summer.

42. *Q.* Your sugarcane wants water all the year round?—None of these tanks grow sugarcane.

43. *Q.* I thought you said the Orsang would grow sugarcane?—We are going to have a big tank on the Heran, or else store water in our own territory.

44. *Q.* That would be so much added to this 10 lakhs that you have in column 4?—Yes.

45. *Q.* That has not been estimated?—One tank on the Orsang has been included in this 10 lakhs.

46. *Q.* Do you want to make storage works outside Baroda territory?—All the works I have proposed are outside Baroda territory, *viz.*, the Sabarmati reservoir, the Nerbudda Canal, the Marbi Canal, and the Heran reservoir.

47. *Q.* If the British Government wanted to make a tank, the site for which was in Baroda territory, would the State make any objection?—I don't think I am authorized to speak on that point.

48. *Q.* (*The President.*)—Have you experimented with different kinds of cotton?—Yes.

49. *Q.* Have you ever tried Egyptian cotton?—Yes.

50. *Q.* Does it succeed?—For two years only, and then it fails.

51. *Q.* Did you give it water?—Only a small quantity.

52. *Q.* In Egypt they water it every two or three years?—I wish to introduce into the State a system of side irrigation; by that system less water is given to the field, and at the same time fairly good crops are grown.

53. *Q.* You know the Egyptian cotton gives a very large produce?—Yes, it is 3½ times that of the Indian cotton.

54. *Q.* How do you account for that?—It is the poverty of the soil; there is no manure applied to the soil in India, while Egypt gets manure from the floods, and there is the lightness of the soil.

55. *Q.* (*Mr. Muir-Mackenzie.*)—Have you served in any other district?—Yes.

56. *Q.* Where does the Orsang project go?—It first passes through the *gorat* and then close to the black soil.

57. *Q.* Does it go past Dabhoi into black soil?—Yes, it passes by Dabhoi on to Shinor into black and *gorat* soil.

58 *Q.* It goes past the river Nerbudda?—It goes towards the Nerbudda.

59. *Q.* Then it will only pass through a small slice of black soil?—Yes.

60. *Q.* What do you propose to do to protect paddy?—We are going to make tanks and repair old ones.

61. *Q.* Is the country like Kaira?—No, it is like the Panch Mahals.

62. *Q.* Are the people principally Bhils?—No, a better class.

63. *Q.* Will they irrigate?—Yes.

64. *Q.* (*Mr. Rajaratna Mudaliar.*)—Is the soil in the north different from the black soil in the south?—Yes; in the north there is *kunkur* in the soil, but not in the south.

65. *Q.* (*Mr. Muir-Mackenzie*)—How did the famine affect the different parts?—The paddy district was affected more than the cotton district.

66. *Q.* What was the reason of that?—The cotton cultivators are of a better class; we had hardly any *kunbis* and *patidars* on our works.

67. *Q.* (*The President.*)—Did they die?—No, they could manage to get on, but they lost their ornaments and bullocks, etc.

68. *Q.* (*Mr. Muir-Mackenzie.*)—It was not that there was a smaller failure of crops?—No.

69. *Q.* Did the census show a material reduction in the growth of the population?—About 19 per cent.

70. *Q.* What is your system of advancing money for wells?—The present system is to give money up to Rs. 500 free of interest; for that no security is required. Under this system Rs. 7,11,284 have been advanced within the last three years.

71. *Q.* Is there any difficulty about recovery?—In the past there has been no difficulty; we have very few bad debts.

72. *Q.* I suppose you remitted a certain amount in the famine?—I will look into that now; I don't think we shall have to remit, because wells have been properly constructed under special officers.

73. *Q.* What is the system?—A special officer is appointed for one or two talukas; he goes round and inspects the sites and finds out whether wells are possible; then he goes to the village and asks people whether they want *takavi*, and explains the rules; when people come forward he examines their fields and sees whether the site is favourable; then he advances money straight off for making a pit; when that is dug, he goes to it and finds out whether the water is good; if the water is good he advances up to Rs. 500 in instalments; if the well fails, or it is salt water, the first advance of Rs. 20 is struck off and not recovered.

74. *Q.* In that way you have given large advances?—Yes, the details are given in Appendix 8.

75. *Q.* The State has constructed some wells?—Yes, and a large number are being constructed by cultivators themselves under Government supervision.

76. *Q.* What return do you get for State wells?—In Amreli 129 wells were constructed by the State; an extra *jirayat* rate is put on; supposing a well is capable of irrigating 6 *bighas* of land, and there are 20 *bighas*, the *jirayat* rate for 6 will be spread over 20 *bighas*.

77. *Q.* What does it pay originally?—The rates vary from Rs. 2·11 per acre.

78. *Q.* When there is a well what additional amount do you put on?—If a well commands 20 acres of land, we multiply Rs. 2·11 by 6, because a well at one time cannot irrigate more than 6 acres, and spread that over 20 acres.

79. *Q.* How do you arrive at Rs. 2·11?—That is the dry crop rate. We charge that rate on the area which the well is estimated to be capable of irrigating, and spread the sum arrived at over the total area commanded by the well.

80. *Q.* (*Mr. Rajaratna Mudaliar.*)—What does a well cost in Amreli?—Rs. 250.

81. *Q.* With regard to what you say in paragraph 18 about pumps being put up in wells, since when has this been going on?—Since the famine, because bullocks began to die and so enterprising people who wanted pumps were given an advance.

82. *Q.* What is the result?—People are pleased with them and are continuing to use them.

83. *Q.* How many are there?—Fifteen.

84. *Q.* Are you able to irrigate large areas?—Yes, one irrigates 200 acres; the machinery cost Rs. 15,000.

85. *Q.* Does the man pay wet assessment?—Not for 30 years.

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86. *Q.* When the Durbar is putting up engines at its own cost does it not levy a water-rate?—No.

87. *Q.* Is the cost of working less than bullock rate?—Where there are 6 *kos* or less bullock power is more economical.

88. *Q.* How long do your wells last?—A *pakka* well about 100 years.

89. *Q.* And *kachcha* wells?—It depends on the locality; in Kadi they last from 5 to 12 years, and some for only a couple of years; they are lined with grass and creepers.

90. *Q.* In paragraph 23 you give the average area irrigated per well; does that represent the area of one crop or both?—One.

91. *Q.* Do most wells irrigate more than one crop?—No.

92. *Q.* What is the object of charging differential rates of interest as stated in paragraph 26?—That is the old system; we have discarded that; our present system is explained in paragraph 28.

93. *Q.* You say in paragraph 29 "a system similar to the Madras system of advancing *takavi* for wells on the security of the well and the land under it up to Rs. 750, recoverable by an additional charge on the land for a long period, has recently been introduced in some parts." Do the people like the permanent addition to their rent?—The measure has just been introduced, and only 229 wells have been made; the people appear to like it, but they require to get accustomed to it. In course of time they may do so.

94. *Q.* Probably that will depend on the amount of the addition?—Yes.

95. *Q.* In Baroda do they like it?—It has not been yet tried; an officer has been transferred to Kadi to see if the people will take to it.

96. *Q.* You say in paragraph 36 that field embankments are suitable for relief labour. Was this resorted to in the last famine?—Only on a very small scale.

97. *Q.* Do you think it will be possible for the State to supervise the construction of these field embankments?—No, it is not possible; if cultivators want to do this work, they can do so by taking *takavi*, but Government cannot undertake it.

98. *Q.* From Appendix I it appears that in Navsari the area irrigated by wells in the famine year fell to 4,636 from 18,319 in a normal year; the decrease appears very high as compared with other districts; what is the reason?—Because they irrigated *kharif* crops, which are not shown; they did not care to irrigate *rabi* afterwards; they went on irrigating *juar*, cutting it down and selling it,—one stook would fetch a pice,—and then they irrigated for fresh shoots; that paid better than any other crop.

99. *Q.* The decrease was not due to failure of wells?—No.

100. *Q.* There is a footnote to Appendix 8 as follows:—"In Amreli 129 wells have been constructed by the State at a cost of Rs. 95,727." Don't you think the average cost, which works out to about Rs. 740, is rather high?—Yes.

101. *Q.* What was the reason of that?—It was done by Government and so all labour had to be paid for, while an ordinary cultivator gets his people and neighbours to work, that is not calculated.

102. *Q.* Could not the cultivator construct wells more economically?—Yes, I think he could.

103. *Q.* (*Mr. Muir-Mackenzie.*)—Was there any part of the State in which they made *kachcha* wells largely in the famine?—In Kadi they did.

104. *Q.* They saved their cattle thereby?—They could not save much of their cattle, but they got some wheat crop.

105. *Q.* (*Mr. Rajaratna Mudaliar.*)—You referred t some high class crops in the early part of your examination: what is the description of crops?—Sugarcane. Under th present system of irrigation what happens is this: when cultivators get water from the canal, which costs them rathe less than the well water, they don't mind wasting a littl more water, and the result of that is the cultivators use fou to five or sometimes ten times more water than the lan really requires. I have found that to irrigate one *bigha* o land of ours, 160 feet by 160 feet, it requires one pair o bullocks for two days, drawing daily about 450 *kos*, eac containing five maunds of water; that is to say, 900 *kos* o water for each watering. Now I have been noticing i Southern India that the people use much more water tha this. They used 900 *kos* of water in the beginning unde well cultivation. But after four years of canal waterin

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the crops began to fail, and the reason was that the soil got chilled. Now this is a very important question. I have been thinking of introducing irrigation works in the Baroda State, and I find that the present system of giving water from the canal results in a wanton waste, and what we want to do is to show the people a system by which they cannot take more water than we like to give them. That system is not to give them more water than what they take under well irrigation. If a well has not more than two *kos*, then the cultivator makes something like 400 *bits*, what are called *charas*; and if he has a larger quantity of water, he makes about 300 or 350 *charas* in one *bigha* of land. Now even that system I call a wanton waste, but what I do is this: I don't make *charas* myself; I simply make a small channel every three or five feet apart, and that channel is ten inches deep and nine to ten inches in width. I fill that channel only, and allow the water to go into the field by percolation. I tried this system and, side by side, I had ordinary well irrigation, and I found that under my system I required less than half the quantity of water. I used 40 to 50 per cent. less than I used with well irrigation, and my crop was better than the ordinary crop.

106. *Q.* (*The President.*)—How much will it cost you per *bigha* to do this?—The manual labour is much less and the profits are greater.

107. *Q* Have you discussed this at all with Mr. Mollison, Director-General of Agriculture?—No, I have not the pleasure of knowing him. After giving the water in this manner on the surface soil, what happens is this. I can cultivate one *bigha* of land in much less time than under the well irrigation system, because under the well irrigation system the soil gets caked, while in the case of my system the soil remains on the top perfectly friable, so my pair of bullocks can do one *bigha* of land in one day.

108. *Q.* You mean that you fill the furrows?—Yes, and they are at a distance of three feet apart.

109. *Q.* (*Sir Thomas Higham.*)—Your furrows, you say, are nine inches deep?—Yes.

110. *Q.* (*Mr. Muir-Mackenzie.*)—Do you make them with the plough?—No. (Illustrates how it is done.) The advantages are so many that I require a less quantity of water, and my cost of cultivation is less and I also get a better crop.

111. *Q.* (*Sir Thomas Higham*)—Have you tried this with well irrigation?—Yes.

112. *Q.* Are the furrows always three feet apart?—Yes; I first tried six feet and failed; then I tried five feet and failed; then I tried four feet,—that was fair; and I succeeded with three feet.

113. *Q* You never allow the water to run off?—No; I fill these furrows once in four days, until the soil is well saturated, then once in seven days.

114. *Q.* All through the crop?—Yes, during the watering season.

115. *Q.* How long does it take for the water to percolate out of the furrows?—If the soil is light, a furrow empties half an hour after it has been filled.

116. *Q.* This is not in black soil?—With black soil what happens is this. In the beginning it takes a very long time to reach the other end of the field on account of the numerous cracks, but when that end is filled, it takes about an hour or a little more than that for the water to disappear into the soil, and then it is all right.

117. *Q.* When do you repeat it again?—We see the condition of the soil and repeat it again, seven or ten days after.

118. *Q.* (*Sir Thomas Higham.*)—It seems to me you give as much water in this way as in the other way?—No, I won't.

119. *Q.* Every watering you give, if spread over the soil, would be three inches on the soil?—It might be.

120. *Q.* If you give it a watering every four days, that would mean a good deal; would not it?—Watering is given only when it is wanted, and not otherwise.

121. *Q.* You find in practice it requires it in four days?—In some crops which require to be grown very rapidly. For instance, *juar* does not require it more than once in fifteen days, and tobacco requires only one watering.

122. *Q.* (*The President.*)—Have you any thought of laying this before Mr. Mollison?—I have not that idea.

123. *Q.* (*Mr. Muir-Mackenzie.*)—How are you going to get your cultivators to adopt it?—That will be a matter of paternal autocracy.

124. *Q.* (*Mr. Rajaratna Mudaliar.*)—Your system won't do for rice cultivation?—No, it is not meant for rice cultivation. This is meant to prevent water-logging; for rice cultivation you require a large quantity of water.

125. *Q.* Don't you waste a large area under your system?—Not at all. In yield I have not suffered at all. I want to ensure Gujerat against famine. Every third year is a bad year, but still Government has been collecting revenue; if the rain in September fails, the crops fail also. I want to utilize the Sabarmati; there is a fine site available, but it belongs to a Thakur; the catchment area is 1,000 square miles, and the rainfall is 40 inches; I want to catch the flood waters only, and so we shall in no way deprive Ahmadabad. If we can construct a tank (site indicated on map), we shall benefit not only Kadi, but certain districts of Ahmadabad; thus, if the cultivator is ensured his *kharif*, he will not be so badly off. Even if we don't get rain in September, there will be ample water in the tank for one watering, which is enough for rape and *bajri*; rape is very valuable, and Government collects its revenue on it. Then, again, I have an experimental measure for a submerged dam (site indicated). The Saraswati shifts its course every now and again, so this course would be useful. Wherever there are such rivers there should be submerged dams. The Kadi district is well watered, and even if they got one or two waterings, that would answer all purposes. There are very favourable sites for tank work. We have constructed as an experimental measure one tank at Kadarpur costing four lakhs. In giving water to this region we want to do something that will suit our requirements and those of the cultivator. Near this tank there are wells with water at 20 feet depth, but 9 to 10 miles away water is not easily to be had; there you go to 70 and 80 feet, and then there is not sufficient water; we don't want to give water where there are wells, but only to those places which are in great need. We want always to keep much more land at our command than the tank water can irrigate, so that we can go on with side irrigation (furrow). We want the co-operation of the British Government in the matters of making irrigation works outside our territory and that especially for the Sabarmati scheme.

MR. G. R. LYN, Chief Engineer, Baroda State.

Mr. G. R. Lyn.

Resumé of the various irrigation projects proposed, partially carried out and entirely completed in Baroda territory to ameliorate scarcity.

In giving a general description of the irrigation projects, I am taking the list given as Appendix No. 7 on the printed information that has already been furnished to the Irrigation Commission by the Baroda authorities and have adhered to the list and numbers as there given. I have shown the locality of each project on the atlas sheets of the topographical survey. I will now proceed to describe each project, taking them in the order of the list in as much detail as will, I think, be of service to the Commission touching where necessary on the salient particular of each project, with my opinion as to their financial prospects and the likely demand for the water, and also bring to the notice of the Commission any difficulties we may have to contend with or are likely to experience on territorial grounds in carrying out such schemes owing to the interference of riparian rights or the intermingling of various jurisdictions.

I shall also give a brief description of such of His Highness' railways as have been or are proposed to be constructed to ameliorate the condition of the country in times of scarcity and scanty rainfall, and I will refer and show these on the same set of maps with distinctive marks for such reference.

BARODA DIVISION.

Haripura Tank No. 1.—This is a small irrigation tank formed by bunding a ravine in the Vaghodia taluka with an embankment 6,550 feet long to retain the water from a catchment of $5\frac{1}{2}$ square miles. About 36 millions cubic feet are impounded when the tank fills and an area of 1,400 acres is commanded all for rice cultivation. The tank was constructed during the last famine at a cost of Rs. 32,940. The

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water from this tank will only be required if the rainfall is insufficient or untimely; it is, therefore, only a protective work.

Karchia Tank No. 2.—This is a similar tank to the above made for the protection of the rice cultivation, embankment 8,500 feet long, catchment area 45 square miles, irrigable area 1,000 to 1,400 acres.

Dubka Tank Project No. 3.—This was a proposal to construct a tank by impounding water in a ravine with a small catchment area to be augmented by a feeder to 11 square miles, and to utilize the water for cultivating the low alluvial lands at the mouth of the Mahi. The project was estimated to cost Rs. 1,26,000 and could probably irrigate 1,500 to 1,800 acres. as this quantity of land was not immediately available and could only be after a period of some years and only if the tidal water could be completely kept from the lands which was uncertain owing to the flooding of the river the scheme was shelved, as it would not be reproductive nor protective.

Orsang Irrigation Works No. 4.—This was a project to dam the water of the Orsang river and use the perennial flow for irrigating lands in the Sankheda taluka. A general scheme was prepared and submitted for the approval of Mr. Whiting, and it is, with modifications suggested by him, being carried out. The weir across the river is completed and the canal and subsidiary works are well in hand. The completed works are estimated to cost 10 lakhs. The dam which is 2,700 feet long is on a rock foundation and 6 feet above the bed level of the river. The take-off for the canal is in a rocky nullah on the right bank which is being converted into the head-works of the canal which reaches the surface between the 4th and 5th mile whence sufficient ground will be at command for all the water available. The catchment area of the Orsang is between 700 and 800 square miles; by the end of February the flow in the river in average years is only a few feet; but up to the end of January it was estimated 140 feet would, in average years, be available, and this Mr. Whiting considered would justify the heavy expenditure proposed on the scheme. During the scanty rain of the past two years, the measured results have not borne out the estimate; and if there is deficiency, there is nothing but to augment the flow by additional works by bringing water to the Orsang catchment from the Heran river. It is possible to do this, but whether it will prove financially successful is a question that can only be stated after the project is gone into and estimates prepared.

Heran River Scheme No. 4-A.—This is a proposal to utilize the flow in the Heran river and from an impounding reservoir by bunding the river near the Pheni Mattu Hill.

Originally the proposal was to bund the river in Baroda territory, but this was found impracticable, as the area commanded and the discharge available would not suffice to make it a financial success without levying excessive charges for water.

The larger scheme, therefore, of forming an impounding reservoir in Chhota Udeypur territory was proposed and leave was obtained to commence the operations for a survey; this, however, was soon withdrawn when it was ascertained that Chhota Udeypur would derive very little benefit and that much ground would have to be given up. On representations, however, from the Political Department Chhota Udeypur again (early in 1901) gave their consent to continue operations, but no definite results are at present known, as the survey has only just been commenced. It would be quite possible from such a scheme as this to augment the Orsang flow, and the works executed for it would form part of this larger proposal.

With regard to the evidence given before the Commission as to feeding the Heran river from the Nerbudda by tunnelling and duct, I have ascertained that this is not feasible, as the bed of the Nerbudda at the locality pointed out is lower than that of the Heran by over 100 feet.

Nerbudda River.—The flow in this river is very considerable, and at present the water runs to waste; it is not used, as I am aware, anywhere even for irrigation or power purposes; I think its capabilities for the former at any rate should be ascertained and any possible schemes prospected that might alike benefit British or Native territory. In this connection I think that His Highness would be willing in the event of any large projected irrigation scheme being formulated in connection with this or other of the large rivers in the Bombay Presidency and located either in British Baroda or other Native territory, to participate, as far as the resources of the State permit, in the cost of any joint scheme that might be located either in British or Baroda territory or other Native States that would benefit Baroda, and he would be prepared to enter into any equitable arrangement as to the disposal of the water available.

Khokhra Tank No. 5.—This is a small impounding tank fed by a perennial stream known as the Vachkadi river constructed during the late famine; it has a catchment area of 4⅓ miles and an embankment 7,400 feet in length with an available quantity of 47 million cubic feet capable of irrigating 633 acres; its cost was Rs. 26,947. This is a protective work and only useful in years of scarcity.

Sarsi Tank No. 6.—This is an existing impounding tank at Desar in the Savli taluka which has been improved and enlarged during the last famine; it has a catchment area of 3⅓ square miles and an available quantity of 39 million cubic feet for irrigation with a cultivable area under command of 4,081 *bighas*; this is a protective and reproductive work.

Muwal Tank No. 7.—This is another old tank in the Savli taluka with a catchment area of 8 square miles and *bund* 6,500 feet long with an available quantity of 160 million cubic feet It was made some years ago for the protection and late irrigation of the rice crop, some 1,600 acres of which it serves; it is protective and partially reproductive.

The Lachraj Tank No. 8.—This is another of the small tanks constructed during the late famine for the protection of the rice crops; it was formed by bunding a natural depression with an embankment 800 feet long and impounding an available quantity of 10½ million cubic feet from a catchment area 2½ square miles. Its cost was Rs. 26,664.

It will be seen from the foregoing that out of the 8 works already constructed in the Baroda Division, there is only one, *viz.*, the Orsang scheme, that can be considered an irrigation work of any importance; the others are simply small impounding tanks made for the protection of the rice crops in times of insufficient and untimely rainfall and which are only protective and non-productive. The Orsang scheme with a plentiful supply of water can be developed into a paying concern; but it is more than probable that this supply will have to be augmented.

NAVSARI DIVISION.

I now come to the Navsari Division. Of the seven works given in the list, four are only in their initial stage and in course of investigation. Hitherto this district has not suffered from any serious famine; the last scarcity affected the Vajpur, Songad, and part of Vyara Mahals. The projects already under investigation will not do anything to alleviate any future distress in two of these districts, *viz.*, Vajpur and Songad. Something might, however, be done with the Tapti for these; but in any case it would have to be with the assistance and support of the British Government, as any interference with the perennial flow would affect British interests in several places. As I have, however, said before, His Highness is quite willing and ready to co-operate if anything can be done.

Jankri River Project No. 9.—This is a proposal to construct a large impounding reservoir by bunding the water of the Jankri river. A site has been selected for a *bund* which will be upwards of 13,000 feet long and 58 feet high, and collect the water from an area of 25 square miles. The approximate available quantity of water would be 2,000 million cubic feet. The cost of the scheme has been roughly estimated at 15 lakhs. The lake would be a wide but short one of about 5 square miles area and capable of irrigating 30,000 acres. The return on this, after allowing for maintenance, would probably not yield more than 3 p. c., and it might be less, as the demand for water, when the rainfall is on an average and excessive, is not so great as in other districts.

Umrat Irrigation Tank No. 10.—This is another of the ordinary irrigation tanks for the protective watering of the rice crops. It is situated in the Navsari taluka and has a capacity, when full, of 69 million cubic feet and is capable of irrigating 800 acres. It cost Rs. 50,000. This with all tanks of similar construction are in years of abnormally deficient rainfall of no use as protective tanks for cultivation, as they fail in their object through not filling.

The Doswada Project No. 11.—This is a scheme for bunding the Mindhola river near the village of Doswada in the Vyara taluka by a *bund* 10,874 feet long and forming a large impounding reservoir with a catchment area of 28¼ square miles and with a capacity of 728 million cubic feet capable of irrigating 11,000 *bighas*. The rough estimate of the scheme comes to 7 lakhs. This might prove productive.

Mr. G. R. Lyn.

The Valvai Project No. 12.—This is a proposal to bund the Madan river in the Vakal taluka and form a reservoir to the east of Vakal; the *bund* would be upwards of 11,000 feet long and from a catchment area of 12 square miles would impound about 550 million cubic feet. The scheme has so far been gone into only in a very cursory way; and from the data available Mr. Whiting expressed it as his opinion that the scheme would only pay 2%, and was of opinion that the reservoir would not fill except in years of large rainfall.

The Purna River Project No. 13.—This is a proposal to construct a reservoir on the Purna river near Antapur in the Vyara taluka by bunding the river. The reservoir which would contain about 3,500 million cubic feet would probably cost from 20 to 25 lakhs and would irrigate 46,000 acres. There is ample land under command, but the project has yet to be thoroughly examined, and it depends on the nature and extent of the dam foundations whether it could be ever carried out with the remotest chance of financial success.

The Bandarpada Project No. 14.—The Bandarpada weir and canal is an old work and is situated in the Songad taluka. It is fed by a small stream and irrigates about 200 *bighas*.

Chikhli Weir No. 14-A.—This weir is constructed in the Vyara taluka across the Mindhola river and irrigates 600 *bighas*. It is an old revenue work and no details are to hand as to its cost.

KADI DIVISION.

The Kadarpur Project No. 15.—This is a reservoir formed by bunding the Rupen river. The earth-work was carried out during the late famine, and consists of an earthen *bund* 12,000 feet long and 27 feet high. It will impound 767 million cubic feet from a catchment area of 30 square miles. It will irrigate lands in the Kheralu taluka between the Rupen and Pashmawati rivers where the sub-soil water is deep and well irrigation costly; 3,700 acres are under command. The *bund* and works are nearly completed and the reservoir is expected to fill in the next rains. The total cost will be Rs. 4,35,000. It is probable that as well irrigation is so costly, the project will prove a financial success.

The Anawada Dam No. 16.—This is a submerged weir that has been built across the Saraswati river below Patan with the object of arresting the under-flow in the sand and raising the water after the monsoon by removeable weir shutters and passing the water thus arrested through a canal to irrigate a portion of the Harij Mahal. At present only the masonry dam and 3 miles of the canal have been executed. The total estimate of all the works is Rs. 2,00,000. The area to be irrigated is 7,500 acres. The quantity of water available depends on the flow in November after the rains; it is expected 100 million cubic feet will be available early in the year; the river is, in ordinary years, quite dry and no flow takes place after January.

The Dharusan Reservoir No. 17.—This is a small impounding reservoir that has been constructed to utilize the flow in the Northern Drainage Channel from Gotwar in the cold season. It will irrigate from 1,000 to 2,000 acres in the north of the Kadi taluka. The head-works are finished and the canal remains to be done. The perennial flow on an average 12 feet per second is the chief source of supply. The estimated cost of the whole is Rs. 61,000.

Vadnagar Tank Feeder No 18.—This is a project for the improvement of an old canal and *bund* and to utilize them for the diversion of a perennial stream from the hill to feed the Vadnagar and Visnagar tanks and utilize the surplus water for irrigation by supplementing the water in the Dharusan project. The reservoir will impound a supply of 35 million cubic feet, and the project will irrigate about 2,500 acres, the estimated cost being Rs 67,000.

The Chhatral Reservoir Project No. 19.—This is a scheme for utilizing the waters of the Kadi Northern and Western Drainage and storing it in an impounding reservoir at Chhatral for irrigating land in the Kadi and Kalol talukas. Plans and estimates have been prepared and held in readiness to carry out this work for relief purposes. It was not considered it would prove a financial success or prove a productive work, and it has so far remained in abeyance.

The Sabarmati or Hadol Scheme No. 20.—This is a project for bunding the river Sabarmati near Hadol by a composite dam nearly 4 miles long and 60 feet in height forming a large reservoir. The water, if it can be impounded, would irrigate land in the southern portion of the Kadi Parant of Baroda territory as well as in the Sanand taluka of British territory. The site of the dam is in the Mahi Kantha Agency and belongs to two Thakurs. For half the width of the river, rock is visible and permission has been obtained to ascertain the nature of the probable foundations of the other portion by sinking trial pits and these are just commenced. It will depend on the favourable nature or otherwise of these trial pits whether the scheme will prove practicable; at this point the river has not a perennial flow. It is impossible at this stage to make any forecast as to the financial results of such a project which may cost anything up to two crores of rupees. It seems certainly to justify the experiments we are carrying out being proceeded with.

The Mazam Project No. 20-A—This project is to divert the flow of the Mazam river, a tributary of the Vatrak, by a weir near Sultanpur near the junction with the Vatrak, and utilizing the flow, which may vary from 10 to 40 cubic feet per second; it would irrigate land in Baroda territory in Dehgam taluka. There would not be likely to be more water than could be used on the small strip of Baroda territory contiguous to it. It is a question as to how the British Government will view this scheme interfering as it would with the flow in the Vatrak river. I am not aware that this water is used, or that there are any works constructed on this river. The project is under development.

AMRELI DIVISION.

The Dhamel Project No. 21.—This is a project for bunding the river Rangoli in the Damnagar taluka and forming a large reservoir impounding 236 million cubic feet. The catchment area above the proposed *bund* is 36 square miles and is principally in Bhavnagar territory. A rough estimate has been made for this work amounting to Rs 6,00,000, and a trial trench was made, but nothing further has been done in the matter, as the Bhavnagar State expressed their intention of objecting to our proceeding with the scheme, interfering as they said it did with the perennial flow and affecting as it would their lands lower down.

The Thebi River Project No. 22.—This project, which cost Rs. 38,000, was for a system of channels and works and repairs to an old masonry *bund* across the Thebi river at Amreli to utilize the flow for irrigational purposes.

The Shingoda River Project No. 23.—This is a scheme for damming the Shingoda river near Ghatwar by a masonry *bund* and utilizing the flow for irrigating land on the left bank of the river. The project has been sanctioned at a cost of Rs. 1,11,783 and commenced during the late famine and the foundations of the dam partially laid. The catchment area is about 150 square miles and the flood discharge of the river is approximately 108,000 cubic feet per second, and in the cold weather from 50 to 100 cubic feet per second according to the rainfall. It is anticipated on an average sufficient water will be available to irrigate 3,000 acres and that this work will be a productive one.

The Pichri Project No. 24.—This is a project for forming a large impounding reservoir and constructing a feeder to it to ensure its filling in the rains from the Sangavadi river. The *bund* is being constructed near the village of Pichvi in the Kodinar taluka and will impound an available supply of 230 million cubic feet and irrigate 5,600 acres. The estimated cost of the scheme is Rs. 3,72,432. The earth-work was commenced during the last famine. There will be no doubt of this reservoir filling even in ordinary bad years as the Sangavadi has a catchment of 20 square miles and a 6″ run-off will be sufficient to replenish it. This work can only be looked upon as protective, as Re. 1 per *bigha* is as much as we can expect to derive and the annual revenue will about balance the maintenance. The Revenue authorities are in favour of it, as it will secure the rayats in years of drought against total failure of their crops.

The Setrunji River Project No. 25.—It was proposed to build a low masonry dam across the Setrunji river above Saramda and utilize the cold-weather flow by turning it into the Mahda tank and thence irrigating the lands of the Kharapat villages, as no reliable data of the discharge of this river had been obtained; and as the question of interference of riparian rights in the Bhavnagar territory through which the river passes to its outlet were brought up, nothing further has been done in the matter. The scheme, however, seems feasible and capable of irrigating some 3,000 to 4,000 acres and might probably be productive.

It will be seen from the foregoing *resumé* that the majority of the larger proposed works are for impounding reservoirs in the Navsari Division, a part of Baroda territory where there is generally an ample fall of rain and consequently less need of protective works; and unless such of these proposals had a reasonable prospect of giving a good return on the money invested, it would be a doubtful policy carrying them out, as they might saddle the State with a financial burden it could not bear.

The Sabarmati scheme deserves thorough examination, but it is one that would have to be carried out as a joint work. For the Baroda Division and for lands in the Panch Mahals, the Mahi, Nerbudda and Heran rivers should embrace some potentialities, and these rivers with the Tapti are, I think, worthy of some special investigation.

Memo. of points to be considered by the Irrigation Commission in the Punjab.

Proportion of protected to cultivable area.

1. For all districts subject to drought the proportion of the cultivable area irrigated by Government canals, district canals, private canals, wells and other sources, respectively, with reference to the population. Figures have been given by Chief Engineer, Irrigation, taken from the Land Revenue Administration Reports, but some explanations will probably be required from Revenue Officers.

Imperial canals.

2. Areas at present irrigated in ordinary and famine years by *existing canals.* Development of irrigation on them during last ten years and further developments anticipated. Duty and improvement of duty.

New projects in contemplation. Their position, scope, and probable irrigating capacity.

Average capital cost of canals per cusec of maximum supply or per acre annually irrigable. Also average gross revenue and working expenses per acre irrigated.

Are many extensions or improvements of minor works which would be certain to prove remunerative or to increase the efficiency of these works held in abeyance owing to restriction of funds available from the ordinary grant?

Ratio of average *rabi* supply to maximum discharging capacity of canals. Possibility and consequences of providing a supplementary *rabi* supply on certain canals.

Drainage of irrigated tracts. Scope for drainage works and other canal improvements, such as diversions or cuts-off, which may be reserved for relief labour in seasons of famine.

Notes on most of these points have been prepared by the Chief Engineer upon which he and his officers will be orally examined. Civil officers will probably also have opinions to offer on some of these points.

Provincial canals.

3. Number and capacities of the Provincial canals. Expenditure on new works and on maintenance during last ten years. New Provincial works, if any, sanctioned or proposed. Extent to which Provincial revenues have been applied to the construction of new irrigation works and the limitations to such application. Does the Province get the whole of the increase of revenue due to the construction of such works? Have present arrangements under the Provincial settlement the effect of encouraging or discouraging the application of Provincial revenues to works of irrigation? Is it desirable that Provincial revenues should in future be devoted to the construction of such works, or should all new works be constructed from Imperial Funds? In what cases should new irrigation works be undertaken as a charge against Provincial Funds.

District irrigation works.

4. Districts in which irrigation works have been constructed or are controlled by the District Boards, or in which there is still a field for such works. Names of existing works, their irrigating capacity, capital cost and gross and net revenue. Should District Boards be encouraged to undertake such work, or may District Funds be reasonably appropriated to such purposes for the benefit of a few landowners? In districts in which new works of this class can be proposed, is it desirable that they should be undertaken by the District Boards, and if not, by what agency should they be constructed or controlled? What credits are made to the Boards on account of these works? Are they empowered by law to levy water rates, or are such rates levied by agreement? Are they entitled to any contribution from Government, in consideration of the increase of land revenue that may be due to the works?

Private irrigation works other than wells.

5. Districts in which private canals of any importance exist. Do the numbers of these canals show a tendency to increase or decrease, and have many or any new private canals been constructed within last ten years? Are such canals constructed by individual landlords for the benefit of their tenants, or by associations of landlords or cultivators, and is water supplied to outsiders, and if so, on what terms? Is it desirable or possible to encourage the multiplication of these works in particular districts, and if so, in what way could encouragement be most effectually given?

Wells.

6. Districts in which the extension or security of cultivation must depend mainly on construction of new wells. Number of new wells constructed in such districts during last ten years. Inducements and assistance offered to landlords or cultivating tenants who propose to sink wells. Are these sufficient and is it likely that the construction of wells would be greatly stimulated by the offer of more liberal inducements or assistance on simpler or easier terms? Average depth of water below surface. Have wells been abandoned owing to failure of the water-supply or from other causes? Average cost of wells and average area irrigated by a well (1) in an ordinary year and (2) in a famine year.

Flood protection and drainage works.

7. Districts in which flood protection or drainage works are required. Are these of sufficient urgency to be carried out whenever funds may be available, or may they be reserved for the employment of relief labour? Would such works lead to any increase or prevent any loss of land revenue, or are they recommended only on sanitary grounds, or as a means of employment for relief labour?

Works executed by relief labour during the famines of 1897 and 1900.

8. Classification of the works on which relief labour was employed in the districts affected, and amount expended on each class, say Roads and Road-metalling—Railway work, including collection of ballast—Irrigation works—Village tanks and other water storage works—Miscellaneous—.

Works uncompleted attend of famine which it is considered desirable to complete as a charge against Provincial on Imperial revenues. Reasons for proposing their early completion and results anticipated. Results attained on completed irrigation or storage works, especially village tanks. Have they been found to hold water and to improve or conserve the resources of the village for watering cattle, etc.?

Programmes of relief works.

9. Districts for which programmes have and have not been prepared. Examination of programmes, especially for districts most liable to famine, with reference to the number of units provided for, the distribution of the works over the district, and their utility. Arrangements for maintaining, extending or completing the programmes.

Memorandum of points to be considered by the Irrigation Commission in Sind.

1. Average area irrigated by each group or system of canals as compared with the cultivable area commanded.

2. Proportion of flow to lift irrigation.

3. Growth of irrigated area during last 20 years, separately for each year for Right and Left Bank Canals but not for each system.

4. Variations in total area as compared with variations in Bukkar gauge, or fluctuations in river supply.

5. Areas that might be brought under irrigation by proposed extensions of existing canals or construction of new ones.

6. Relation of the total irrigated area to total cultivable area in Province.

7. Area depending on well cultivation unassisted by canals.

8. Canals which are ordinarily able to obtain a perennial or cold weather supply.

9. Extent to which the supplies to the canals have been affected if at all by the withdrawals for new canals in the Punjab.

10. Has the necessity for a weir at Bhakkar, as proposed by Sir E. James, been felt?

11. What canals would be benefited by the construction of such a weir and to what extent?

12. Have any investigations been made to show the practicability of such a weir?

13. Do the results so far attained on Jamrao Canal indicate that it will be as successful and that it will irrigate as large an area as anticipated in the revised estimate?

14. Areas, if any, irrigated from private canals, which are not under control of Irrigation Department or referred to in the Administration Report.

15. Generally, what scope is there for extensions of irrigation in Sind including Kelat or other foreign territory and in what order should they be considered?

Memorandum of points to be considered by the Irrigation Commission in the Bombay Presidency.

SIND.

1. A memorandum of the points, on which the Sind officers will be asked to give information, has already been forwarded demi-officially to the Secretary to the Government of Bombay, Public Works Department.

GUJERAT.

Cultivable and irrigable areas, etc.

2. The gross and cultivable areas in each district and the proportions of the latter which are protected by Government irrigation works, by private or village works and by wells respectively. Character of the soil. Extent to which cultivation is dependent on artificial irrigation. Rainfall. Is there ordinarily a demand for water in Gujerat during south-west monsoon? What are the crops which require irrigation and how many waterings do they require, and at what times of the year? How is the distribution controlled, and in what form is irrigation revenue realised?

Black cotton soil.

3. Experience as regards black soil. Do small tanks constructed in such soil hold water, and can high earthen dams be made of it without masonry core walls? When the land irrigated is a black soil, is there any demand for water during seasons of average rainfall or only in case of prolonged drought? In such soils does the irrigated area show a falling off in years of fair or good rainfall owing to slack demand and is the revenue more precarious on this account than on tanks commanding other classes of soil? Has there been a desire for irrigation works on the part of owners of black soil, and is the construction of tanks for such soil considered as remunerative or as important as for other classes of soil?

Government irrigation works.

4. Description of existing Government irrigation works. Total annual irrigating capacity, and range of variation. Are these works to be depended on in a season of drought? Particulars regarding completed and proposed works as in the memorandum by Inspector General of Irrigation, dated 7th May. Question of utilising the waters of the Narbada, Tapti and Sabramati for irrigation of Gujerat districts. Any other possible sources of irrigation.

Provincial irrigation works.

5 Number and capacities of the Provincial irrigation works. Expenditure on new works and on maintenance during last ten years. New Provincial works, if any, sanctioned or proposed. Extent to which provincial revenues have been applied to the construction of new irrigation works and the limitations to such application. Does the Province get the whole of the increase of revenue due to the construction of such works? Have present arrangements under the Provincial settlement the effect of encouraging or discouraging the application of Provincial revenues to works of irrigation? Is it desirable that Provincial revenues should in future be devoted to the construction of such works, or should all new works be constructed from Imperial Funds? In what cases should new irrigation works be undertaken as a charge against Provincial Funds?

District or village works.

6. By whom constructed and controlled. Number of such works and aggregate extent of cultivation dependent on them. Responsibilities of Government in connection with their maintenance as fixed at former settlements. Average annual expenditure, if any, incurred by Government on these works excluding expenditure on relief works during late famines. Is any irrigation realized or are remissions of land revenue given when the works fail? Have new works of this class been constructed of late years otherwise than as famine relief works? Are such works undertaken by District Boards or by private landowners? Is it desirable that District Funds should be expended on such works? Has it been the practice for Government to encourage the construction of such works by loans to District Boards or to land owners? Can the protective value of these works be increased by devoting more money and greater attention to their up-keep, and by encouraging the construction of new works? Enforcement of local responsibilities in this connection. Value of such works as concerning village water-supplies for men and cattle, without reference to irrigation.

Wells.

7. Total area irrigated by wells in ordinary years and in years of drought. Number of new wells constructed annually during last ten years. Extent to which construction has been assisted by advances from Government. Concessions, if any, given to the constructors of new wells. Is it possible or desirable to stimulate the construction of new wells by more liberal advances or inducements? Extent to which wells have been affected by the droughts of 1899-1901. Were any of those which ran dry deepened, and if so, with what results? Number failed or abandoned. Average depth of water below surface and cost of wells used for irrigation, and area served by each. Reports by Mr. Crimp and Geological Officers on possibility of artesian wells in Gujerat.

Drainage works.

8. Districts or tracts in which lands or crops are injured by water-logging or excess of water in very wet years Are additional drainage works required, either on sanitary or agricultural grounds? Source from which funds would be provided for such works. Would they result in any increase of revenue, or in preventing loss of revenue now remitted after seasons of flood?

Works executed by relief labour.

9. Classification of the works on which relief labour was employed in the districts affected, and amount expended on each class, say Roads and Road-metalling—Railway work, including collection of ballast—Irrigation works—Village tanks and other water storage works—Miscellaneous—.

Works uncompleted at end of famine which it is considered desirable to complete as a charge against Provincial or Imperial revenues. Reasons for proposing their early completion and results anticipated. Results attained on completed irrigation or storage works, especially village tanks. Have they been found to hold water and to improve or conserve the resources of the village for watering cattle, etc.?

Programmes of relief works.

10. Districts for which programmes have and have not been prepared. Examination of programmes, especially for districts most liable to famine, with reference to the number of units provided for, the distribution of the works over the district, and their utility. Arrangements for maintaining, extending or completing the programmes.

11. General inquiries will be made in regard to irrigation works in Kathiawar, with reference more particularly to the works carried out during the late famine as in paragraph 9.

Deccan.

Statistics for typical works.

12. Inquiries will be made as in Gujerat as in paragraphs 2 to 9. In addition statistical information will be required regarding all the larger or typical irrigation works in the Deccan as below :—

I.—Initial statistics.

- Area and nature of catchment.
- Assumed average annual rainfall.
- Full supply capacity of tank in m. c. feet.
- Percentage of capacity on assumed average rainfall.
- Water spread at full supply.
- Maximum height and total length of dam.
- Cost of dam, waste weir, sluices.
- Compensation for land submerged by tank.
- Cost of canal and distributing channels.
- Total capital cost.

II.—Annual statistics for each year since completion :—

- Rainfall of the year.
- Amount stored during year.
- Amount run over waste weir.
- Total run off for the year.
- Percentage of run off on rainfall of the year.
- Area irrigated during the year in acres.
- Quantity of water if any left in tank at end of irrigating season and available for next year.

Initial statistics of the same kind should be given for all new projects which have been sufficiently investigated, the proposals for which will be considered by the Committee.

Irrigation receipts and charges.

13. Scale of water rates on major and minor works. Are applications for water received annually, and how is distribution controlled? Effect of years of favourable rainfall on the demand for irrigation and on irrigation revenue. Are tanks always empty at end of irrigating season, or do any carry supplies on to following year? Do the irrigation works get a fair credit for the increase of revenue due to their construction, or is this increase limited to the amount realized as water rate? Are the charges for maintenance and establishment fair or exaggerated by reason of the same establishment being employed also on civil works? Generally may the revenue accounts of these works be accepted as correctly indicating the financial results attained on them.

Value of works in reducing claims for famine relief.

14. Protective value of the Deccan irrigation works during the famine of 1897 and subsequently. Areas irrigated. Was famine relief necessary either in the form of employment on relief works or of gratuitous relief extended in the villages protected by these works, or can any estimate be formed of the extent to which the cost of famine relief would have been increased if these works had not been in operation?

Questions for Public Works Officers, Madras.

Proportion of irrigated to cultivated area.

1. For all districts liable to drought the proportion of the cultivable and occupied area now annually irrigated from Government irrigation works, tank works maintained by Government for which no revenue accounts are kept, private canals or storage works, wells, and other sources, with reference to the total area of the district and to the population?

Major irrigation works.

2. Areas at present irrigated in ordinary and famine years by existing major works. Developments of irrigation on them during last fifteen years, and further developments anticipated. Duty and improvement of duties. Proportion of second to first crop cultivation, and possibilities of extending the former?

Capital cost of the works per cusec of maximum supply or per million cubic feet stored. Also average gross revenue and working expenses per acre annually irrigated. Net revenue realised up to date on each of the works?

Drainage of irrigated tracts. Scope for drainage and other canal improvements, such as diversions and cuts-off, which may be reserved for relief labour in time of famine?

Possible new major works.

3. Feasibility and probable cost of constructing extensive storage reservoirs on the larger rivers in the Presidency, such as the Godavari, the Kistna or the Cauvery, or on such of their tributaries as may be relied on to run large surplus supplies during the summer months, even in the most unfavourable years. Quantity of water that could be stored, and area on which it would be utilized. Probable character of the demand, whether constant in all seasons or likely only to be strong in seasons of drought. Quality of the soil?

Minor works for which Capital and Revenue or Revenue accounts only are maintained.

4. Irrigating capacity, in each district, of minor works for which Capital and Revenue or Revenue accounts only are maintained. Liability of these works to fail in seasons of drought. Average gross revenue and cost of maintenance per acre irrigated.

Examination of particular projects for new works of this class. Financial and agricultural or protective results anticipated?

Field for works of this class. Proposals which have been made in each district but have not yet been fully investigated?

Is the multiplication of works of this kind hindered by want of funds, or by want of projects which have been carefully prepared and fully examined? Would progress of such works be facilitated if they could be constructed from loan funds? Have many projects, which were estimated as likely to prove directly remunerative, been held in abeyance solely for want of funds?

Minor works for which neither Capital nor Revenue accounts are maintained.

5. Number and irrigating capacity, in each district, of minor works (neither Capital nor Revenue) under the care of Public Works and Civil Officers respectively. What rights over them does Government possess and what are the duties and responsibilities of Public Works and Civil Officers in respect of such works, and to what extent are the owners or other persons interested in them responsible for their maintenance? Expenditure incurred by Government on these works and the areas irrigated by, and estimated amounts of revenue dependent on, them during last 25 years, or shorter period if figures for full 25 years not available?

Object of the tank investigation scheme. Number of works investigated and the area and revenue dependent on them. Number of works on which improvements have been carried out, the cost of the improvements, the average area irrigated and revenue derived before and after the improvements. Number of works investigated more than three years ago but not taken up for repairs for want of funds?

Brief statement of the work done and remaining to be done, and of the expenditure already incurred —

(i) on the work of survey or investigation ;

(ii) in carrying out improvements recommended by the survey parties ;

(iii) on clearances and other works of ordinary maintenance ;

Has there been any marked improvement in the protection afforded by works, which have been repaired under the tank restoration scheme, either as regards extent or certainty, which may be attributed to this expenditure, or has the expenditure sufficed to prevent retrogression? Is there a possibility of increasing the number of these works? Would it be possible to improve greatly the efficiency of these works if more funds could be annually made available for the purpose? How is the distribution of the funds now made available determined, *i.e.*, on the reports of the Tank Investigation parties or the recommendations of the Revenue officers, superior or subordinate, or the representations of the owners of the tanks or other persons interested in them ; and with whom rests the final decisions between rival claims? Would any alteration of the existing system in this respect be necessary or desirable in the event of largely increased grants being placed at the disposal of the Public Works officers?

Private irrigation works.

6. Are there any private tanks or other irrigation works which are maintained entirely by the owners without any assistance from Government? What is the size and irrigating capacity of the largest of these? Can new works of this kind be constructed without the permission of Government or without reference to the possible effect in intercepting the supply to other tanks under Government control, or has any inconvenience been experienced from the existence of private irrigation works over which the Revenue or Public Works officers have no power of control?

Wells.

7. In what district is well cultivation most largely practised? Are the crops matured entirely by wells, or is there some other source of irrigation which is supplemented by wells? Depth and variations in spring level in such localities. Observed effects of tanks in raising or maintaining the spring level in wells. Average yield and irrigating capacity of wells. Probable maximum yield per square mile of country. Cost of constructing and working.

Soils.

8. General experience as to irrigation requirements of different soils. Do small tanks constructed in black cotton soil hold water, and can high earthen dams be made of it without masonry core walls? When the land irrigated is black soil, is there any demand for water during seasons of average rainfall or only in case of prolonged drought? In such soils does the irrigated area show a falling off in years of fair or good rainfall owing to slack demand, and is the revenue more precarious on this account than on tanks commanding other classes of soil? Has there been a desire for irrigation works on the part of owners of black soil, and is the construction of tanks for such soil considered as remunerative or as important as for other classes of soil?

Flood protection and drainage works.

9. Districts in which flood protection or drainage works are required. Are these of sufficient urgency to be carried out whenever funds may be available, or may they be reserved for the employment of relief labour? Would such works lead to any increase or prevent any loss of land revenue, or

are they recommended only on sanitary grounds, or as a means of employment for relief labour?

Classification of works on which relief labour was employed in famine of 1897.

10. Classification of works on which relief labour was employed in the districts affected, and amount expended on each class, say roads and road-metalling, railway work (including collection of ballast) irrigation works, village tanks and other water storage works, miscellaneous?

Works uncompleted at end of famine which it is considered desirable to complete as a charge against Provincial or Imperial revenues. Reasons for proposing their early completion and results anticipated. Results attained on completed irrigation or storage works, especially village tanks. Have they been found to hold water and to improve or conserve the resources of the village for watering cattle, etc.?

Programme of relief works.

11. Districts for which programmes have and have not been prepared. Examination of programmes, especially for districts most liable to famine, with reference to the number of units and percentage of population provided for, the distribution of the works over the districts, and their utility. Arrangements for maintaining, extending or completing the programmes.

Memorandum of points to be considered by the Irrigation Commission in Bengal.

1. *For districts or tracts liable to famine or scarcity.*—Gross and cultivated or occupied areas of each district; average gross area annually under crop and the probable proportions of the cropped area which are irrigated by Government irrigation works, by private or village works, and by wells, respectively. General configuration of the country; character of the soils, and their suitability for irrigation. Extent to which cultivation is dependent on artificial irrigation; statistics of annual and monthly rainfall. Years in which reliable records show that there has been (1) famine, and (2) severe scarcity not amounting to famine. Staple crops for each main class of soil; times at which sown and reaped. What are the crops which require irrigation, and how many waterings do they require and at what times of the year. Utility of irrigation in increasing the produce of the land and in securing it from the effects of a failure of the rainfall. General measures which should be adopted for extending irrigation in each district, either by Government or private works.

2. *Existing Government irrigation works (Imperial).*—General statement giving the following information for each work:—Capital outlay to end of 1900-01; annual gross revenue, maintenance charges, net revenue, percentage of net revenue on *mean* capital outlay, and area irrigated based on an average for the 10 years ending 1900-01. Particulars regarding each work as in the memorandum by the Inspector General of Irrigation, dated 7th May 1901. Form in which irrigation revenue is realised. Are the works credited with all the revenue to which they seem fairly entitled? Protective value of the works during recent years of drought.

3. *Proposed new Government works.*—Particulars regarding each work as in the memorandum by Inspector General of Irrigation dated 7th May 1901. General statement of proposed new works showing for each the estimated capital cost, and financial result, and the area to be irrigated in each district. Possible scope for works showing other than those which have been proposed.

4. *Provincial works.*—Particulars as in paragraph 2 regarding any works for which capital and revenue accounts may be kept. List and brief description of works for which capital and revenue accounts are not kept; total expenditure incurred on such works; total receipts; areas irrigated and annual maintenance charges. Are the works credited with all the revenue to which they seem fairly entitled? Protective value of the works during recent years of drought. Expenditure on new provincial works during the last 10 years. New Provincial works, if any, sanctioned or proposed. Extent to which Provincial revenues have been applied to the construction of new Provincial works and the limitation to such application. Does the Province get the whole of the increase of revenue due to the construction of such works? Have the present arrangements under the Provincial settlement the effect of encouraging or discouraging the application of Provincial revenues to works of irrigation? Is it desirable that Provincial revenues should be devoted in future to the construction of such works or should all new works be constructed from Imperial funds? In what cases should new irrigation works be undertaken as a charge against Provincial funds?

5. *Private Irrigation works other than wells.*—Brief description of such work (including field embankments) by whom constructed and controlled; state of repairs; their liability to failure in a year of drought; obstacles, if any, to their extension. Extent to which construction has been assisted by advances from Government. Concessions, if any, given to the constructors of such works. Obstacles to their extension and possibility of stimulating their construction in tracts liable to famine. Can new works of this kind be constructed without the permission of Government or without reference to their possible effect in intercepting the supply to either Government or private works?

6. *Wells.*—Districts or tracts in which well cultivation is most largely practised. Average depth of water below general surface in each district or tract; cost of wells used for irrigation; average area irrigated per well. Extent to which the supply of water is affected by drought. Concessions, if any, given to the constructors of new wells. Is it possible or desirable to stimulate the construction of new wells by more liberal advances or inducements?

7. *Black cotton soil.*—Where prevalent; usual depth; nature of the underlying stratum. Is there any desire for irrigation on the part of the cultivators of such soils? Extent to which the suitability of these soils for irrigation is affected by their depth, and by the facilities for natural drainage afforded by the stratum underlying them.

8. *Water rates and distribution of water on Government works.*—Scale of water rates on major and minor works. How is the distribution of water arranged for and controlled? Effect of years of favourable rainfall on the demand for irrigation, and on irrigation revenue.

9. *Loans for improvements.*—Total amount of loans advanced in each district under the Land Improvement and Agriculturists' Loans Act, respectively, and total amount of loans expended on works of irrigation during each of the past ten years. Number of works of each class (wells, tanks, etc.) constructed, improved or repaired by means of these advances.

10. *Programmes of relief works.*—Districts for which programmes have and have not been prepared. Procedure adopted in preparing the programmes, more especially as regards the selection of 'village works' and other small works which are generally carried out by Civil Agency. Examination of programme with special reference to the number of units and percentage of population provided for; the number of units requiring relief in the most severe famine on record; the distribution of the works over the district, and their utility. In tracts where drainage or flood embankment is more required than irrigation, information as to any projects of the kind which would be suitable for entry in the relief works programmes.

Memorandum of points to be considered by the Irrigation Commission in the United Provinces of Agra and Oudh.

1. *Extension, etc., of existing irrigation works.*—Are many extensions or improvements of existing works, which would be certain to prove remunerative or to increase the efficiency of the works, held in abeyance owing to restriction of funds?

2. *Financial arrangements.*—Have present arrangements under the provincial settlement the effect of encouraging or discouraging the extension of irrigation?

3. *Expansion of irrigation from existing works.*—Main features and results of the policy adopted during recent years for the expansion of irrigation from existing canals by remodelling the channels, readjusting the size and location of outlets, and improving generally the system of distribution. Further scope for similar improvements.

4. *Duty of water.*—Improvement effected of recent years in the duty of water. Probable percentages of

supply at head of canals still lost by percolation, etc., from (1) Main Canal, (2) Distributaries, (3) Watercourses. Results of any experiments that may have been made with reference to the question of rendering the channels watertight by puddling or otherwise.

5. *Distribution of water.*—How is the distribution of water controlled and the share of each village and cultivator determined, more especially with reference to the more recently constructed channels.

6. *Index of protection—Protected and unprotected tracts.*—In the light of recent experience what is considered to be (1) the proportion of the average area annually sown which must be matured, and (2) the proportion of the normal *rabi* area which must be irrigated, to ensure a tract against famine. Situation, areas, and populations of districts or tracts which, in the absence of artificial irrigation, would be liable to suffer from drought; map of same. Proportion in each district or tract which the area irrigated in dry year bears to the normal *rabi* area. Mean annual rainfall of each district or tract. Years in which district or tract suffered from drought or would probably have suffered in the absence of irrigation; and the rainfall of each of these years.

7. *Storage works.*—The feasibility of holding over a sufficient supply from ordinary years so as to afford the fullest possible amount of protection to the crops in a year of drought. The following particulars in regard to one or two typical storage works:—

I.—Initial statistics.

1. Area and nature of catchment.
2. Average annual rainfall over catchment.
3. Full supply capacity of tank in million cubic feet.
4. Percentage of capacity on run-off due to total average rainfall.
5. Water-spread at full supply.
6. Total capital cost.
7. Scale of water rates.

II.—Annual statistics for typical years.

1. Rainfall of year.
2. Amount stored during year.
3. Amount run over waste weir.
4. Total run-off for the year.
5. Percentage of run-off on total rainfall of year.
6. Area irrigated during the year in acres.
7. Quantity of water, if any, left in tank at end of irrigating season and available for next year.

8. *Wells.*—A memorandum and statements (*vide* form attached), showing for each district and province the number of wells (*pakka*, *kachcha* and total), in use for irrigation during each of the past ten years; gross area of crops irrigated by the wells in each year; the average area of crops irrigated per well in (1) a specified normal year and (2) in a specified year of drought; the average depth from ground to water surface; the average cost of a *pakka* well; and of a *kachcha* well; the amount of *takavi* advanced in each year for the construction or repair of wells; the number of wells constructed or repaired by means of these advances. Districts in which the extension or security of cultivation must depend mainly on the construction of new wells.

9. *Private irrigation works other than wells.*—Districts in which private irrigation works (including field embankments) exist. Brief description of such works and desirability and possibility of encouraging their further construction in certain districts.

10. *Black cotton soil.*—Usual depth of black cotton soils and nature of the underlying stratum. Extent to which the suitability of these soils for irrigation is affected by their depth and by the facilities for natural drainage afforded by the stratum underlying them. Average increase of produce due to the irrigation of the various descriptions of black soils, as shown by any crop cutting experiments that may have been made during recent years.

11. *Flood protection and drainage works.*—Drainage of canal irrigated districts; total expenditure incurred; and results obtained, beneficial and otherwise. Necessity for the further construction of drainage works in canal-irrigated and other districts.

12. *Famine relief works.*—Total expenditure incurred on each class of relief works—Roads and Road-metalling, Railways, Irrigation Works, Village tanks for water-supply, and Miscellaneous—in each of the districts affected by the famine of 1896-97. Works uncompleted at the end of the famine which it is considered desirable to complete as a charge against Imperial or Provincial revenues. Reasons for proposing their completion. Result attained on completed irrigation or storage works. Arrangements made for the control and maintenance of such works.

13. *Famine relief programmes.*—Districts for which programmes have and have not been prepared. Examination of programmes, especially those of districts most liable to famine, with reference to the number of units provided for, the distribution of the works over the district, and their utility. Maps of proposed works. Arrangements for maintaining, extending or completing the programmes.

Memorandum of points to be considered by the Irrigation Commission in Jaipur.

1. *Total number of works, modern and ancient.*—Total number of irrigation works completed and in progress; are these all storage works or do they include any canal, taking off direct from rivers without storage works? Of the total number how many are old works that have been in operation from time immemorial, and how many are either new or completely restored works carried out since Colonel Jacob went to the State?

2. *Growth of irrigated areas.*—Total areas in acres recorded as irrigated by the State works for each year from 1872, so as to show progress of irrigation.

3. *Particulars for typical works.*—The following particulars in regard to a few typical works:—

I.—Initial statistics—

Area and nature of catchment.
Assumed average annual rainfall.
Full supply capacity of tank in m. c. feet.
Percentage of capacity on assumed average rainfall.
Water spread at full supply.
Maximum height and total length of dam.
Cost of dam, waste weir, sluices.
Compensation for land submerged by tank.
Cost of canal and distributing channels.
Total capital cost.

II.—Annual statistics for each year since completion—

Rainfall of the year.
Amount stored during year.
Amount run over waste weir.
Total run off for the year.
Percentage of run off on rainfall of the year.
Area irrigated during the year in acres.
Quantity of water if any left in tank at end of irrigating season and available for next year.

4. *Annual expenditure.*—Can total expenditure on all works recorded since 1872 (about 58 lakhs) be distributed between (1) capital outlay and (2) cost of maintenance and repairs? Do the charges shown, either as capital outlay or on maintenance include cost of all establishments, including share of Executive Engineer's and Superintending Engineer's pay, and also the cost of revenue collection?

5. *Revenue.*—Scale of water rates for flow and lift—single and double crops, etc. Is this uniform for all works, and independent of the number of waterings given? Are remissions of water rate given when crops fail to come to maturity? How is the rate levied? Is it taken at the same time as the share of produce?

How is share of produce taken? Is it taken in kind or a cash valuation? If so, how is the cash value determined and what is the share taken?

In case of *jagir* lands, does the State only get the water rate? Do Jagirdars contribute anything towards the cost of the works?

Do not the amounts shown as revenue in the annual reports include under "share of produce" a certain amount of revenue which was realizable before the construction of the works, or are the whole amounts shown fairly and entirely creditable to the works?

6. *Distribution and duty.*—What are the crops mainly irrigated, and how many waterings do they usually receive? During what period is water given out, and how is the distribution controlled and the duration of times of each cultivator determined? What is considered a fair average duty per million cubic feet stored, including losses by evaporation, absorption, etc.?

7. *Black cotton soil.*—Experience as regards black soil. Do small tanks constructed in such soil hold water, and can high earthen dams be made of it without masonry core walls? When the land irrigated is a black soil, is there any demand for water during seasons of average rainfull or only in case of prolonged drought? In such soils does the irrigated area show a falling off in years of fair or good rainfall owing to slack demand, and is the revenue more precarious on this account than on tanks commanding other classes of soil? Has there been a desire for irrigation works on the part of owners of black soil, and is the construction of tanks for such soil considered as remunerative or as important as for other classes of soil?

8. *Future extensions.*—Apart from the enlargement and improvement of existing works, are any new works of considerable size proposed or considered possible in Jaipur? If so, in what tracts, and what would be the probable area of new irrigation? Is the field for new works restricted because their construction would seriously interfere with the supply to existing works within the State? Are there any possible irrigation projects, the construction of which would benefit the State, but cannot be contemplated owing to objections that may be raised by neighbouring States, to interference with the water-supply, or to the necessity of carrying the channels through the territory of another State?

9. *Relief works.*—What were the works on which relief labour was mainly employed during late famine? Were any new irrigation works commenced and completed, or if not completed, is it now proposed to complete them? Can useful employment be found for relief labour in improving or strengthening existing works or on the construction of proposed new works, and are any programmes of possible irrigation relief works maintained?

Memorandum for Engineer Officers of additional points to be considered by the Irrigation Commission in Hyderabad and Mysore.

1. *Population, areas, etc.*—The population, and gross cultivable and average cropped areas, in each district of Division, and the area irrigated in (*i*) a normal year, (*ii*) in a year of drought by State irrigation works, private or village works, and wells respectively?

2. *Soils.*—General character of the soil. Brief description of each important class of soil and of its distribution over the country. General experience as to irrigation requirements of different soils.

3. *Black cotton soil.*—Experience as regards black soil. Do small tanks constructed in such soil hold water, and can high earthen dams be made of it without a masonry core wall? When the land irrigated is black soil, is there any demand for water during the seasons of average rainfall or only in case of prolonged drought? In such soil does the irrigated area show a falling off in years of fair or good rainfall owing to slack demand and is the revenue more precarious on this account than on works commanding other classes of soil? Has there been a desire for irrigation works on the part of owners of black soil, and is the construction of works for such soil considered as remunerative or as important as for other classes of soil?

4. *State irrigation works.*—Number and description of the State irrigation works and their total capital cost. Total area irrigated by the works (*i*) in a dry year, (*ii*) in a normal year. Average annual working expenses and total and net revenue. Are these works to be depended on in a season of drought?

5. *Future extensions.*—Are any new works of considerable size proposed or considered possible in the State? If so, in what tracts and what would be the probable area of new irrigation?

6. *Village or private irrigation works, excluding wells*—Are there any village or private irrigation works excluding wells? If so, by whom are they constructed and maintained? Number of such works and aggregate extent of cultivation dependent on them. Is any expenditure incurred by the State on these works or any increase in revenue, direct or indirect, derived from them?

Is there any considerable scope for the construction [illegible] new works of this class? If so, in what tracts and what would be the probable area of new irrigation?

7. *Crop irrigated, distribution, and duty.*—What are the crops usually irrigated in each season by (*i*) canals, (*ii*) tanks, and (*iii*) wells? How many waterings do they usually require? During what period is water given out? How is the distribution from (*i*) and (*ii*) controlled and the time for which water is allotted to each cultivator determined? What is considered a fair average duty per cubic feet per second of discharge or per million cubic feet stored, including loss by evaporation, absorption, etc.?

8. *Statistics for typical works.*—Statistical information regarding some of the larger or typical storage works:—

I. Initial statistics.

- Area and nature of catchment.
- Assumed average annual rainfall.
- Full supply capacity of tank in m. c. feet.
- Percentage of capacity on assumed average rainfall.
- Water spread at full supply.
- Maximum height and total length of dam.
- Cost of dam, waste weir, sluices.
- Compensation for land submerged by tank.
- Cost of canal and distributing channels.
- Total capital cost.

II. Annual statistics for each year since completion.

- Rainfall of the year.
- Amounts stored during the year.
- Amount run over waste weir.
- Total run off for the year.
- Percentage of run off on rainfall of the year.
- Area irrigated during the year in acres.
- Quantity of water, if any, left in tank at end of irrigating seasons and available for next year.

9. *Flood protection and drainage works.*—Districts in which flood protection or drainage works are required. Are these of sufficient urgency to be carried out whenever funds may be available, or may they be reserved for the employment of relief labour? Would such works lead to any increase or prevent any loss of land revenue or are they recommended only on sanitary grounds or as a means of employment for relief labour?

10. *Relief works.*—On what classes of work was relief labour mainly employed during the late famine? Were any new irrigation works commenced and completed, or if not completed, is it now proposed to complete them?

Memorandum of points to be considered by the Irrigation Commission in Central India.

1. *Population and area.*—Population and gross area of State; cultivated or occupied area; average area annually under crop; areas irrigated respectively by State works, private or village works, and wells in (1) a normal year and (2) a year of drought.

2. *Physical features, soils, rainfall, etc.*—General configuration of the character of the soils, and their suitability for irrigation. If any black cotton soils, where prevalent; usual depth; nature of the underlying stratum; is there any desire on the part of the cultivators for the irrigation of such soils? Statistics of rainfall.

3. *Crops, etc.*—Staple crops grown in each main class of soil; times at which sown and reaped. What are the crops which require irrigation; how many waterings do they require and at what times of the year? Rental of irrigated and unirrigated lands. Is the State's share taken in cash or as a share of the produce? If the latter, is it taken in kind or at a cash valuation?

4. *Famines.*—Years in which reliable records show that there has been (1) famine and (2) scarcity not amounting to famine. Areas most liable to famine.

5. *State irrigation works.*—Total number and cost of State irrigation works, completed and in progress. Are these all storage works, or do they include any canals taking off direct from rivers without storage works? General financial and protective results attained. Form in which irrigation revenue is realized by the State. Scale of water-rates for flow and lift, single and double crops. Are remissions of water-rate given when crops fail to come to maturity? Arrangements for maintenance of the works and for the distribution of the water. Do the works irrigate *jagir* lands; if so, to what extent, and on what terms is the water given? Possibility of improving existing works, and possible increase in the area irrigated.

6. *Proposed new State works.*—List of proposed new State works; probable cost, and probable area of new irrigation. Scope for works other than those which have been proposed. Is the field for new works restricted owing to objection that may be raised by neighbouring States to interference with the water-supply, or owing to the necessity of carrying the channels through the territory of another State?

7. *Private irrigation works other than wells.*—Brief description of such works, including works in *jagir* lands; state of repair; their liability to failure. Obstacles, if any, to their extension and possibility of stimulating their construction in tracts liable to famine.

8. *Wells.*—Average depth of water below ground surface; cost of wells used for irrigation; total number of such wells; average area irrigated per well. Extent to which the supply of water is affected by drought. Concessions given to the constructors of new wells. Amount of loans advanced by the State during the past 10 years for the construction of wells and other irrigation works and the terms upon which such loans have been given.

9. *Field embankments.*—Are embankments made by the cultivators for the purpose of holding up water to moisten the soil? If so, to what classes of soil and crops are they found to be most suitable? Their effect in (1) increasing the outturn in ordinary years; (2) ensuring a crop in a year of drought; (3) eradicating or preventing the growth of *kans* grass and weeds; (4) rendering the crop more liable to rust in wet years.

10. *Relief works.*—What were the works on which relief labour was mainly employed during the late famine? Were any new irrigation works commenced and completed, or if not completed, is it now proposed to complete them? Can useful employment be found for relief labour in improving or strengthening existing works, or on the construction of proposed new works? Are any programmes of relief works maintained? Suitability or otherwise of field embankments for the employment of relief labour.

Questions for Revenue Officers, including Officers of the Public Works Department, who have had experience of the administration of water-supply.

N.B.—Officers are requested to answer those questions only regarding which they can give information from personal knowledge, or from authentic source.

A. General.

1. To what district or tract do the answers below refer? What opportunities have you enjoyed of becoming acquainted with it?

2. What is the average rainfall in each month of the year?

3. Is there any obstacle to the extension of irrigation arising from—

(1) sparsity of population?

(2) insufficient supply of cattle suited to the cultivation of irrigated land?

(3) insufficient supply of manure?

(4) unsuitability of soil (*e.g.*, black cotton soil) to irrigation?

(5) uncertainty of the supply of water or its too late commencement or too early cessation?

(6) lack of capital for the initial expenditure or of funds for the more expensive cultivation of irrigated crops?

(7) fear of enhanced rent or revenue assessment?

(8) uncertainty of tenure or defects of the Tenancy Law?

(9) other reasons?

4. For what period, if any, is land which is irrigated from works constructed by private capital exempted from enhancement of assessment on account of the irrigation? How is the exemption secured in practice? Is any similar exemption from enhancement of rent extended to tenants who have extended irrigation to their holdings at their own cost? Do you consider that the existing provisions in this respect are sufficiently liberal? If not, what alterations would you suggest?

5. Are loans under the Land Improvement Act freely taken by the people for the extension of irrigation? If not, why not, and what measures would you suggest for the encouragement of these loans? Would you recommend—

(1) reduction of the rate of interest?

(2) remission of the interest?

(3) partial remission of the advance?

(4) total remission in case of failure of the attempt to obtain water?

(5) extension of the period of repayment?

(6) grants-in-aid?

6. Does not extension of irrigation tend to injure the remaining cultivation by attracting its cultivators to the irrigated tracts?

Can you give any instance of this which has come to your knowledge? Is there any strong desire evinced among the people of your district to have means of irrigation extended to it or increased?

B.—Canals of continuous flow.

7. To what extent does the irrigation increase the value of the produce of land—

(1) by rendering it possible to cultivate two harvests instead of one?

(2) by leading to the substitution of more or less valuable crops or varieties?

(3) by increasing the yield—

(*a*) in a year of ample rainfall?

(*b*) in a year of scanty rainfall?

(*c*) in a year of drought?

8. Can you give an approximate estimate of the increase in the total annual value of the produce per acre due to the irrigation—

(1) on the average of a normal term of years?

(2) in a year of drought?

9. What is approximately the average annual rate per acre paid on account of irrigation—

(1) by the cultivator (or the owner?) of the land to the owner of the canal in the form of water rate or otherwise?

(2) by the cultivator to the owner of the land in the form of enhancement of rent or otherwise?

(3) by the owner of the land to the Government in the form of enhancement of revenue, water advantage rate, owner's rate or otherwise?

In each case please state whether the rate is paid on the area actually irrigated during the year, on the area ordinarily irrigated, on the whole irrigable area, on the total area of the holding, or how.

10. What, if any, private expenditure is necessary to bring the water to the field or to prepare the land for irrigation? Is this generally incurred by the landlord or by the tenant? If by the latter, what security has he for recoupment?

11. Has any damage resulted to the people or deterioration to the soil from irrigation without manure, from too profuse, too extensive, or too frequent irrigation, from water-logging, salt efflorescence or otherwise? If so, what is its form, its extent, and, in your opinion, its cause and the possible remedy? Of what standing respectively are the irrigation in question and the evil which has sprung from it? Is the latter increasing? What is your experience of the results of draining irrigated land?

C.—Canals of intermittent flow.

N. B.—Small irrigation channels, supplied by temporary dams thrown across a river-bed, are included under this heading.

12. Please describe generally—

(1) the manner in which the————canal (or group of canals) in the————district is supplied with water;

(2) the manner in which the water is distributed to the land;

(3) the period for which the supply is ordinarily maintained—

(*a*) in a year of ample rainfall;

(*b*) in a year of scanty rainfall;

(*c*) in a year of drought.

13. To what extent does the irrigation increase the value of the produce of land—

(1) by rendering it possible to cultivate two harvests instead of one?

(2) by leading to the substitution of more for less valuable crops or varieties?

(3) by increasing the yield—

(*a*) in a year of ample rainfall?

(*b*) in a year of scanty rainfall?

(*c*) in a year of drought?

14. How far is the value of the irrigation diminished by—

(1) the too late commencement?

(2) the too early cessation of the supply?

15. Is the irrigation ordinarily supplemented by irrigation from wells given to the same land and, if so, how far is this essential?

16. Can you give an approximate estimate of the increase in the total annual value of the produce per acre due to the irrigation—

(1) on the average of a normal term of years?

(2) in a year of drought?

17. What is approximately the average annual rate per acre paid on account of irrigation—

(1) by the cultivator (or the owner?) of the land to the owner of the canal in the form of water rate or otherwise?

(2) by the cultivator to the owner of the land in the form of enhancement of rent of otherwise?

(3) by the owner of the land to the Government in the form of enhancement of revenue, water advantage rate, owner's rate or otherwise?

(4) by the owners of the canal to the Government in the form of royalty?

In each case please state whether the rate is paid on the area actually irrigated during the year, on the area ordinarily irrigated, on the whole irrigable area, on the total area of the holding, or how.

18. What, if any, private expenditure is necessary to bring the water to the field or to prepare the land for irrigation? Is this generally incurred by the landlord or by the tenant? If by the latter, what security has he for recoupment?

19. Has any damage resulted to the people or deterioration to the soil from irrigation without manure, from too profuse, too extensive or too frequent irrigation, from water-logging, salt efflorescence or otherwise? If so, what is its form, its extent, and, in your opinion, its cause and the possible remedy? Of what standing respectively are the irrigation in question and the evil which has sprung from it? Is the latter increasing? What is your experience of the results of draining irrigated land?

20. How is the maintenance (repairs, silt clearance and the like) provided for, and what is the approximate annual cost per acre irrigated? Does the system work fairly well and is any legislation required?

21. Were any of the canals constructed by private persons? Has any trouble arisen in such cases in regard of the supply of water by the owners of the canal to other owners of land, or of the realisation of dues for the same? Has it been found necessary for Government to take over the management of any private canals, and, if so, why?

22. Do you consider it advisable to encourage and assist the construction by private persons of further canals, and if so, how could this best be done?

D.—Tanks.

23. Please describe generally—

(1) the way in which the tanks in the————district are supplied with water;

(2) the manner in which the water is distributed to or utilised upon the land;

(3) the period for which the supply is ordinarily maintained—

(*a*) in a year of ample rainfall;

(*b*) in a year of scanty rainfall;

(*c*) in a year of drought.

(4) the area ordinarily irrigated from a tank

24. To what extent does the irrigation increase the value of the produce of land—

(1) by rendering it possible to cultivate two harvests instead of one?

(2) by leading to the substitution of more for less valuable crops or varieties?

(3) by increasing the yield—

(*a*) in a year of ample rainfall?

(*b*) in a year of scanty rainfall?

(*c*) in a year of drought?

25. How far is the value of the irrigation diminished by—

(1) the too late commencement?

(2) the too early cessation of the supply?

26. Is the irrigation ordinarily supplemented by irrigation from wells given to the same land and, if so, how far is this essential?

27. Can you give an approximate estimate of the increase in the total annual value of the produce per acre due to the irrigation—

(1) on the average of a normal term of years?

(2) in a year of drought?

28. What is approximately the average annual rate per acre paid on account of irrigation—

(1) by the cultivator (or the owner?) of the land to the owner of the canal in the form of water rate or otherwise?

(2) by the cultivator to the owner of the land in the form of enhancement of rent or otherwise?

(3) by the owner of the land to the Government in the form of enhancement of revenue, water advantage rate, owner's rate or otherwise?

In each case please state whether the rate is paid on the area actually irrigated during the year, on the area ordinarily irrigated, on the whole irrigable area, on the total area of the holding, or how.

29. What, if any, private expenditure is necessary to bring the water to the field or to prepare the land for irrigation? Is this generally incurred by the landlord or by the tenant? If by the latter, what security has he for recoupment.

30. How is the maintenance (watching, repairs, silt clearance and the like) provided for? What is the approximate annual cost per acre irrigated? Does the system work fairly well and is any legislation required?

31. In the case of tanks constructed by a private person or persons how is the distribution of water to the other owners of land regulated or arranged for? Has any trouble arisen in this respect or in connection with the realisation of water dues? If so, is Government assistance advisable and is any legislation required?

32. Do you consider it advisable to encourage and assist the construction by private persons of further tanks; and, if so, how could this best be done?

33. Is much inconvenience experienced from the liability of tanks to silt up? Can you give any statistics as regards

the depth of silt accumulation per annum? Is it the custom to remove the silt by dredging or otherwise? If not, what steps are taken to prevent the ultimate silting up of the whole tank?

E.—Wells.

34. Please state generally for each of the main tracts into which the——district is divided—

(1) the average depth of permanent wells;

(2) the nature of the supply, whether from springs or from percolation, and whether liable to fail or become too saline to use—

(*a*) in an ordinary year;

(*b*) in a year of drought;

(3) the average cost of construction;

(4) the average duration of a well;

(5) the manner in which the water is usually raised;

(6) the average area attached to and commanded by a well;

(7) the average area irrigated in any one year.

35. To what extent does the irrigation increase the value of the produce of land—

(1) by rendering it possible to cultivate two harvests instead of one?

(2) by leading to the substitution of more for less valuable crops or varieties?

(3) by increasing the yield—

(*a*) in a year of ample rainfall?

(*b*) in a year of scanty rainfall?

(*c*) in a year of drought?

36. Can you give an approximate estimate of the increase in the total annual value of the produce per acre due to the irrigation—

(1) on the average of a normal term of years?

(2) in a year of drought?

37. What is approximately the average annual rate per acre paid on account of the irrigation—

(1) by the cultivator to the owner in the shape of enhancement of rent?

(2) by the owner to Government in the shape of enhancement of revenue?

Are these rates paid on the total area attached to and commanded by the well or on the area actually irrigated during the year, or how?

38. Are serious difficulties often encountered—

(1) in the selection of a spot in which a supply of water will be obtained?

(2) in the actual construction of the well?

Has assistance ever been offered by Government or by local bodies in the shape of expert advice, trial borings, the use of boring tools, or otherwise? If so, how far has this assistance been made use of and found successful? If not, do you think it would be useful and how could it best be given?

39. Are you in favour of the construction by Government of wells in land which is private property? If so, how would you work the scheme? If not, what objections do you perceive?

40. Are temporary wells commonly used in the——district? How far are they a protection against drought? How would you propose to encourage their construction in a year of scanty rainfall?

STATISTICAL STATEMENTS.

Statement of Population, Cultivation, and Irrigation in British Territory (excluding Lower Burma and Assam).

Presidency or Province.	Population.	Area cultivable but not cultivated.	Cultivated area, including current fallows.	Gross area under crop in a normal year	Gross area irrigated.		Percentage on normal cropped area.		Remarks.
					In a year of normal rainfall.	In a year of drought.	Of area irrigated in a normal year.	Of area irrigated in a dry year.	
	Thousands.	*Thousand acres.*	*Thousand acres.*	*Thousand acres.*	*Thousand acres.*	*Thousand acres.*			
1	2	3	4	5	6	7	8	9	10
Punjab	22,357	20,503	29,062	28,207	10.430	11,002	37·0	39·0	(*a*) Exclusive of the Presidency towns of *Bombay*, *Madras*, and *Calcutta* and *Howrah* respectively.
Bombay	(*a*) 14,529	1,428	29,980	24,327	1.077	1,043	4·4	4·3	
Sind	3,211	6,669	8,031	3,323	2,923	2,341	88·0	70·4	(*b*) Exclusive of permanently settled zamindaris or proprietary estates.
Madras	(*a*) 37,690	(*b*) 6,103	(*c*) 39,715	36,574	10,532	9,500(?)	28·8	25·9	
Central Provinces	9,877	14,710	19,295	16,814	700	253	4·2	1·5	(*c*) Inclusive of 11,613 thousand acres of zamindaris.
Bengal	(*a*) 73,047	11,772	58,519	63,665	6,349	6,349(?)	10·0	10·0	
United Provinces	47.692	11,005	37,450	41,086	11,055	11,520	26·9	28·0	
Upper Burma	3,846	8,224	5,625	4,666	828	600	17·7	12·9	
Baluchistan	308	(Not available.)			5	3	...	...	
Ajmer-Merwara	477	92	461	388	142	51	36·6	13·1	
Berar	2,754	233	7,848	6,820	56	66	0·8	1·0	
Coorg	181	47	240	195	1	1	0·5	...	
Total .	215,969	80,786	236,226	226,065	44,098	42,731	19·5	18·9	

Statement of gross areas irrigated from different sources in British Territory, excluding Lower Burma and Assam (in thousands of acres).

PRESIDENCY OR PROVINCE.	IN A YEAR OF NORMAL RAINFALL.									IN A YEAR OF DROUGHT.								
	STATE WORKS.			PRIVATE WORKS.					GRAND TOTAL.	STATE WORKS.			PRIVATE WORKS.					GRAND TOTAL.
	Canals.	Tanks.	Total.	Canals.	Tanks.	Wells.	Other sources.	Total.		Canals.	Tanks.	Total.	Canals.	Tanks.	Wells.	Other sources.	Total	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Punjab . . .	5,590	...	5,590	900	30	3.750	160	4,840	10,430	5,600	...	5,600	1,014	33	4,155	200	5,102	11,002
Bombay . .	80	192	272	15	...	650	140	805	1,077	54	183	237	5	..	714	87	806	1,043
Sind . . .	2,772	...	2,772	...	...	41	110	151	2,923	2,218	...	2,218	...	...	23	100	123	2,341
Madras . . .	3,656*	2,544	6,200	13	2,475	1,821	23	4,332	10.532	(Information not available.)								9,500(?
Central Provinces .	...	...	...	6	594	77	23	700	700	...	...	...	1	176	64	14	255	255
Bengal . . .	743	...	743	...	...	661	4.945	5,606	6,349	(Information not available.)								6.349(?)
United Provinces .	2,546	3	2,549	...	2,090	5.731	685	8.506	11,055	3,028	4	3.032	...	991	7,041	456	8 488	11,520
Upper Burma . .	251	169	420	301	5	4	98	408	828	(Information not available.)								600
Baluchistan . .	5	...	5	(Information not available.)					5	3	...	3	(Information not available.)					3
Ajmer-Merwara .	...	36	36	...	...	106	...	106	142	...	7	7	...	...	44	...	44	51
Berar . . .	...	...	...	...	...	54	2	56	56	...	...	...	...	...	66	...	66	66
Coorg . . .	1	...	1	...	...	...	...	. .	1	1	...	1	(Information not available.)					1
TOTAL .	15,644	2,944	18,588	1,235	5,194	12,895	6,186	25,510	44,098	10,904	194	11,098	1,020	1,200	12,107	857	15,184	42,731

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* Includes irrigation from other sources (Spring, Channels, etc.)

Statement of Population, Cultivation, and Irrigation in Native States.

Serial No.	NAME OF STATE.	Population in 1901. *Thousands.*	AREA TO WHICH THE IRRIGATION STATISTICS REFER.		IRRIGATION FROM DIFFERENT SOURCES IN 1900-01.						REMARKS.
			Total. *Thousand square miles.*	Annually under crop. *Thousand acre.*	State canals. *Thousand acre*	State tanks. *Thousand acre.*	Private tanks. *Thousand acre.*	Wells. *Thousand acre.*	Other sources. *Thousand acre.*	Total. *Thousand acre.*	
1	2	3	4	5	6	7	8	9	10	11	12
1	Baroda	1,953	8	2,550	..	5	...	179	...	184	The statement does not include the Hill States of the Punjab, United Provinces, and Bengal; nor many other States of the latter Province. In all of these there is but little irrigation. Nor does it include the Burmese States. A number of smaller States, aggregating about 36,000 square miles, for which no statistics are available, are also excluded.
2	Hyderabad	11,141	83	16,000	10	462	...	200	100	772	
3	Mysore	5,449	28	6,132	105	540	...	70	230	945	
4	Central India	5.920	69	10.668	...	64	132	305	94	595	
5	Rajputana	8,475	113	6,491	70	150	37	801	114	1,172	
6	Madras States	4,144	9	1.090	199	58	14	5	349	625	
7	Bombay States, including Kathiawar.	7,254	60	20.131	157	6	1	746	53	963	
8	Bengal States	877	7	1,237	20	69	73	5	183	353	
9	United Provinces States	533	1	402	36	...	...	3	...	39	
10	Punjab States	4,220	35	4.225	1,389	...	2	238	329	1.958	
11	Central Provinces States	1,360	25	2,150	12	21	49	4	71	157	
	TOTAL .	51,326	438	71,076	1,998	1,375	311	2,556	1,523	7,763	

PUNJAB.

Statement I—Showing present condition of districts with reference to Population, Cultivation, and Irrigation.

Serial No.	Name of District.	Annual Rainfall.			Population.		Area cultivable but not cultivated.	Cultivated area.	Gross areas of crops sown.		Gross areas of crops matured.					Gross area irrigated in 1899-1900	Percentage of column 17 on column 12.	Total wet cultivation in 1899-1900.
		Average.	1899.	1900.	In 1901.	+ or — since 1891.			Normal.	In a dry year (1899-1900)	Average area.	Average per head of population.	In a dry year (1899-1900).	Percentage of column 14 on column 12.	In 1900-1901.			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Ins.	Ins.	Ins.			Acres.	Acres.	Acres	Acres	Acres.	Acres.	Acres.		Acres.	Acres.		Acres.
1	Simla	48·4	25·9	46·70	40,351	—4,291	21,541	10,020	15,241	13,991	13,100	·32	7,025	53·6	12,783	886	6·8	886
2	Kangra	65·4	44·8	85·89	768,124	+5,094	260,885	589,626	775,354	710,651	664,752	·89	474,538	69·3	729,297	175,814	25·7	175,814
3	Hoshiarpur	33·5	19·8	56·98	989,782	—21,877	174,381	730,253	949,848	871,184	859,480	·87	649,900	75·6	853,253	114,785	13·4	114,785
4	Jullundur	25·2	11·5	43·35	917,587	+10,004	65,194	697,890	855,124	725,705	778,830	·85	594,026	76·3	845,511	411,670	52·9	433,786
5	Sialkot	27·9	11·4	33·87	1,083,909	—35,938	166,440	944,306	1,072,786	852,974	960,299	·89	646,641	63·2	1,115,940	491,998	51·2	539,257
6	Rawalpindi	30·7	20·4	41·21	930,535	+43,341	241,695	1,128,108	1,251,858	1,162,835	986,445	1·06	612,230	62·1	1,078,615	59,950	6·1	66,491
7	Hazara	36·3	26·5	39·62	560,288	+44,000	390,700	631,238	567,407	495,703	543,092	·90	428,379	85·1	670,783	59,549	11·8	59,549
8	Kohat	20·6	16·9	23·33	217,865	+14,690	189,194	321,673	286,095	257,359	229,250	1·05	176,875	77·2	250,313	33,671	14·7	33,697
9	Bannu	12·5	9·8	13·20	656,073	+283,797	710,184	895,200	745,268	607,288	638,342	·97	431,798	67·6	660,890	158,016	24·8	224,256
	Total tract A	33.4	20·8	42·68	6,164,514	+338,820	2,220,214	5,948,314	6,518,981	5,697,690	5,653,640	·92	3,981,392	70·4	6,185,385	1,506,339	26·6	1,639,521
10	Shahpur	13·2	5·3	12·13	524,259	+30,671	1,263,436	759,565	665,412	453,972	483,833	·92	309,329	63·9	554,684	230,377	47·6	274,626
11	Dera Ismail Khan	10·3	8·3	9·84	252,379	—233,822	3,672,986	992,088	763,788	612,195	653,502	2·59	507,817	77·7	715,771	148,836	22·8	514,933
12	Dera Ghazi Khan	6·4	2·3	6·60	471,149	+67,118	1,465,714	943,085	626,869	503,353	530,087	1·13	410,117	77·4	597,210	235,709	44·5	408,667
13	Muzaffargarh	6·8	0·6	4·53	405,656	+24,561	1,180,629	502,412	500,956	405,096	475,813	1·17	403,744	84·8	501,135	321,589	67·6	411,740
14	Multan	5·3	1·8	4·52	710,626	+79,182	2,450,114	993,659	830,749	753,981	726,575	1·02	542,765	74·7	773,094	454,644	62·6	541,583
15	Montgomery	8·5	2·9	6·33	463,586	—35,835	1,855,491	578,912	578,340	377,924	449,805	·97	294,208	65·4	572,893	328,892	73·1	348,657
16	Jhang	9·6	2·6	5·84	1,170,556	+733,715	2,583,660	1,514,639	1,093,420	1,306,200	1,049,413	·90	1,231,058	117·3	1,662,965	1,183,034	112·7	1,240,042
	Total tract B	8·5	3·4	7·11	3,998,211	+665,500	14,352,030	6,284,560	4,929,534	4,472,721	4,369,028	1·09	3,699,038	84·7	5,377,752	2,903,081	66·4	3,740,448
17	Hissar	14·8	4·9	21·90	781,717	+5,711	510,619	2,676,978	2,215,055	1,560,582	1,211,181	1·55	197,704	16·3	2,014,169	221,006	18·2	224,158
18	Rohtak	19·9	11·0	33·10	630,672	+40,107	117,567	967,323	994,600	814,471	777,362	1·23	197,918	25·5	1,103,672	144,777	18·6	144,961
19	Gurgaon	22·1	11·7	26·96	746,208	+77,279	87,370	997,081	1,069,473	923,267	923,399	1·24	383,385	41·5	1,096,216	210,909	22·8	211,909
20	Delhi	23·7	10·0	30·38	689,039	+50,350	124,134	545,595	594,947	488,994	521,726	·76	317,641	60·9	657,953	216,915	39·7	213,420
21	Karnal	22·9	8·2	32·97	883,225	+199,507	579,341	1,148,882	1,053,369	846,248	865,085	·98	437,047	50·5	1,177,130	349,353	40·4	376,025
22	Umballa	38·0	21·4	55·25	815,880	—217,547	95,072	765,301	978,860	764,542	788,221	·98	333,938	41·8	873,012	79,925	10·0	102,633
23	Ludhiana	24·4	10·9	39·54	673,097	+24,375	51,033	768,823	867,314	748,783	762,642	1·13	550,498	72·2	824,492	216,775	38·9	343,894
24	Firozpur	14·3	5·0	19·46	958,072	+71,396	291,340	2,156,463	2,045,719	1,337,173	1,533,072	1·60	938,133	61·1	2,079,371	862,302	56·2	890,213
25	Lahore	16·9	5·8	18·20	1,162,109	+86,730	507,123	1,350,962	1,252,811	854,248	1,033,342	·89	730,925	70·7	1,325,654	758,936	73·4	788,237
26	Amritsar	21·7	7·3	29·46	1,023,828	+31,131	88,926	787,140	938,940	785,330	865,810	·85	660,162	76·2	949,927	596,614	68·9	610,428
27	Gurdaspur	41·0	19·6	53·91	940,334	—3,588	95,586	848,096	974,169	887,458	908,726	·97	703,325	77·4	977,307	256,416	28·2	370,402
28	Gujrat	23·9	10·4	28·07	750,548	—10,327	165,620	840,419	877,614	655,193	718,220	·86	344,647	48·0	914,033	193,490	26·9	233,964
29	Gujranwala	18·6	7·5	14·90	756,797	+66,628	640,838	1,115,770	1,002,116	810,666	876,064	1·16	686,439	78·3	1,120,088	662,811	75·6	689,299
30	Jhelum	19·0	11·8	25·46	594,018	—15,038	230,446	1,031,929	1,045,288	745,804	757,856	1·28	213,458	28·2	940,567	38,147	5·0	62,165
31	Peshawar	15·6	11·0	20·07	788,707	+84,939	346,173	886,324	888,619	757,448	832,722	1·06	618,103	74·2	953,471	424,701	51·0	449,073
	Total tract C	22·5	10·4	29·98	12,194,251	+491,743	3,931,188	16,829,026	16,758,994	13,105,317	13,386,078	1·1	7,313,323	54·6	17,007,062	5,303,067	39·6	5,710,800
	GRAND TOTAL	22·5	11·8	28·50	22,356,976	+1,496,063	20,503,432	29,061,900	28,207,509	23,275,728	23,408,746	1·05	14,993,753	64·1	28,570,199	9,712,487	41·5	11,090,769

PUNJAB.

Statement II—Showing gross areas irrigated from different sources in each district.

Serial No.	District.	1898-99.							1899-1900.							1900-1901.							Number of wells in use in 1899-1900.		
		Canals.		Tanks.	Wells.	Other sources.	Total.	*Sailab* and other wet cultivation.	Canals.		Tanks.	Wells.	Other sources.	Total.	*Sailab* and other wet cultivation.	Canals.		Tanks.	Wells.	Other sources.	Total.	*Sailab* and other wet cultivation.	Masonry.	Temporary	Total.
		Government.	Private.						Government.	Private.						Government.	Private.								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.			
1	Simla	...	..	...	...	1,158	1,158	..	...	...	...	...	886	886	..	...	..	...	...	1,246	1,246	...	...	...	...
2	Kangra	...	172,597	...	...	...	172,597	..	..	175,814	..		...	175 814	...		172,752	...	...	..	172,752	...	4	78	83
3	Hoshiarpur	...	21,422	295	44,985	5,132	71,834	...	...	25,452	298	83 427	5,610	114,785	...	..	18,655	67	18 498	4,487	41,687	...	5,691	15,412	21,108
4	Jullundur	...	...	...	388,316	1,932	390,248	29 162	..	.	...	410,626	1,044	411,670	22,116	...	...	...	307 008	956	307,964	34,388	26,897	1,419	28,316
5	Sialkot	...	10,352	...	459,004	40,311	509,667	76,081	...	13,273	...	475 137	3,588	491,998	38,259	...	9,784	...	346,566	36,286	392,636	116,179	23,133	1,973	25,106
6	Rawalpindi	...	15,657	...	44,684	...	60,341	9,631	...	14,907	...	45 043	...	59,950	6,541	...	6,507	...	26 873	..	33,380	11,801	6,293	898	7,189
7	Hazara	...	57,668	...	1,558	..	59,226	...	...	57,879	...	1,670	.	59,549	...	...	69,611	..	22 888	.	92,499	919	252	78	330
8	Kohat	...	...	1,356	1,719	37,044	40,119	19	...		1,161	1,860	30,650	33,671	26	...	...	1,162	2,011	38,974	42,147	31	386	163	549
9	Bannu	...	156,896	...	3,729	...	160,625	55,619	...	153,564	...	4,452	...	158,016	66,240	...	165,766	...	4,322	...	170,088	83,591	541	26	567
	Total Tract A	...	434,692	1,651	943,995	85,577	1,465,815	170,712	...	440,889	1,457	1,022,215	41,778	1,506,339	133,182	...	443,075	1,229	728,163	81,928	1,254 399	246,907	83,197	20,045	83,242
10	Shahpur	43,169	24,159	...	160,542	...	227,870	44,902	53,216	31,312	...	145,849	..	230,377	44 249	83,691	49 071	..	162,153	...	294,915	66,538	7,489	279	7,768
11	Dera Ismail Khan	...	41,757	...	107 001	446	149 204	363,227		37,281	...	111,144	411	148,836	366,097	...	46,800	...	118,251	277	165 328	498,947	6,908	857	7,765
12	„ Ghazi „	163,654	442	..	49,102	11,752	224 950	186,636	171,638	240	...	47,297	16,534	235,709	172,958	222,585	340	..	40,574	20,962	284,441	298,201	9,390	2,071	11,461
13	Muzaffargarh	287,639	...	680	45,583	12,830	346 732	97,445	257,153	..	695	46,509	17,232	321,589	90,151	316 451	...	1,769	43,667	22,250	384,137	111,989	15,024	2,411	17,435
14	Multan	391,421	10,617	...	123,628	7,121	532 797	89,845	251,535	11,149	...	181,361	10,605	454,644	83,939	560,854	13,611	..	68 295	9,550	652,310	120,144	19,950	4,194	24,144
15	Montgomery	183,923	3,736	...	213 393	7,240	408,282	23,075	139,268	6,393	...	177,533	5,678	328,892	19,965	285 480	6,615	...	152,894	6 446	451,425	151,294	11,156	1,502	12,658
16	Jhang	658,069	739	...	242,549	3,489	904,846	62,917	976,331	1,014	...	195,553	10,131	1,183,034	57,008	1,335,481	1,144	...	226,421	5,715	1,568,761	104,510	16,235	452	16,687
	Total Tract B	1,727,875	81,450	680	941,798	42,878	2,794,681	868,037	1,849,161	87,383	695	905,246	60,596	2,903,081	837,357	2,604,522	117,581	1,769	812,255	65,190	3,801,317	1,351,623	86,152	11,766	97,918
17	Hissar	193,115	6,946	1,100	7,160	...	208 321	7,640	203,336	7,983	707	8,980	...	221,006	3,152	213,114	3,954	..	826	7	217,901	58,327	993	434	1,427
18	Rohtak	145,317	...	...	30,376	..	175 693	...	113,745	...	..	31,030	2	144 777	184	116,789	.	...	16,271	...	133,060	...	2,770	3,597	6,367
19	Gurgaon	73,540	...	46	101,531	1,914	177,031	9,114	96,862	...	90	113,019	938	210,909	1,000	60,109	...	4	67,000	8,893	136,006	31,105	9,189	7 918	17,107
20	Delhi	95,817	...	272	107,071	...	203,160	11,842	84,979	...	669	121,257	.	206,905	6,515	49,297		21	50,071	...	99,389	33,650	9,546	3,235	12,781
21	Karnal	189,004	7,837	8,770	125,129	97	330 837	79,519	183 666	4,787	1,993	158,662	245	349 353	28,672	139 515	13,393	1,714	49,949	4	205,078	121,345	10,775	784	11 559
22	Umballa	3,490	...	3,805	28,107	10,803	46 205	30,256	4 879	...	4,590	61,489	8,967	79,925	22,708	3,707	...	374	10,680	7,140	21 901	32,236	3,229	13,699	16,928
23	Ludhiana	71,601	...	548	180,190	...	252,339	53,719	95 855		647	200 273	...	296,775	47,119	66,257		176	127 465	..	193,898	57,313	9,924	1,536	11 460
24	Firozpore	482,035	119,065	..	149,574	...	750,674	31,504	565,690	108,042	.	198 570	..	872,302	27,911	475,205	235,782	.	89,458	..	800,445	45,764	8,066	1,252	9,318
25	Lahore	480,377	...	7,956	296,236	17,181	801,750	32,650	466,489	..	4,990	271,707	15,750	758,936	29,301	616,397	...	22,694	227,023	29,517	895,631	135 850	14,937	2,341	17,278
26	Amritsar	291,486	...	950	277,358	2,758	572,562	25,829	287,291	.	306	308 111	906	596 614	13,814	289,900		1,163	182,145	1,445	474 653	31,915	11,731	413	12,144
27	Gurdaspur	46,285	28,069	4,528	121,590	..	200,472	132,350	54,517	29,534	3,785	168,580	...	256 416	113,986	49,193	28,558	2,252	85,936	16	165 955	146,745	6,922	4,004	10,926
28	Gujrat	...	...	...	189,469	...	189,469	54,579		...	...	193,490	...	193,490	40,494	.	...	..	154,547	...	154,547	61,844	9,837	1,082	10,979
29	Gujranwala	295,136	...	931	343,478	...	639,544	29,224	375,067	...	120	287,624	...	662,811	26,468	491,672	...	2,227	300,088	...	793,987	48,999	12 548	269	12,817
30	Jhelum	...	308	...	36,787	1,771	38 866	24,359	375	..	...	37,772	...	38,147	24,018	494	54	..	36,715	1,270	38,533	33,016	4,740	383	5,123
31	Peshawar	164,296	163,616	...	77,043	4,898	409,853	35,834	186,646	156,581	...	76,573	4,901	424,701	24,371	216,850	171,072	..	78,971	5,265	472,158	45,883	10,235	1,101	11,336
	Total Tract C	2,531,496	324,841	28,906	2,071,109	39,422	4,995,776	557,419	2,719,397	306,927	17,897	2,227,137	31,709	5,303,067	477,733	2,788,490	453,316	30,628	1,477,145	53,557	4,803,145	903,992	125,502	42,046	167,550
	GRAND TOTAL	4,259,373	840,983	31,237	3,956,902	167,877	9,256,272	1,596,168	4,568,558	835,199	20,049	4,154,598	134,083	9,712,487	1,378,282	5,393,021	1,013,972	33,626	3,017,566	200,676	9,858,861	2,502,522	274,851	73,859	348,710

BOMBAY PRESIDENCY.

Statement I.—Showing present condition of districts with reference to Population, Cultivation, and Irrigation.

Serial No.	Name of District.	ANNUAL RAINFALL.			POPULATION.		Area cultivable but not cultivated.	Cultivated area.	GROSS AREA OF CROPS SOWN.				GROSS IRRIGATED AREA. AVERAGE OF FIVE YEARS ENDING		Gross area irrigated in 1899-1900.	Percentage on normal (col. 10) sown area of gross area irrigated in 1899-1900.	NUMBER OF WELLS IN USE.		
		Average.	In 1899.	In 1900.	In 1901.	+ or — since 1891.			Normal.	Per head of population.	1899-1900.	1900-1901.	1896-97.	1900-1901.			1891-92.	1901-1902.	+ or — in 1901-1902 as compared with 1891-92.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
							Acres.	Acres.	Acres.		Acres	Acres	Acres.	Acres.	Acres.				
1	Ahmedabad	30·0	6·4	21·4	795,967	—125,745	155,207	1,568.660	1,305,772	1·63	290,373	828,379	64,123	75,809	116,714	8·9	14,526	16,862	+2,336
2	Kaira	34·0	6·7	24·4	716,332	—155,257	95,860	726,340	730,045	1·02	280 816	558,798	33,546	57,062	90 217	12·4	8,708	11,146	+2.438
3	Panch Mahals	38·2	10·3	28 2	261,020	—52,397	102 775	622,589	425 849	1·63	216,913	204,828	2,612	3,647	7,759	1·8	1,365	2,816	+1,451
4	Broach	36·3	9·2	30·2	291,763	—49,727	31,538	644,198	572,575	1·96	104,005	499,785	1,588	2,619	6,154	1·1	703	1,180	+477
5	Surat	54·8	21·0	50·6	637,017	—12,972	46,206	754,227	537,968	0·84	367,423	462,629	20,134	20,808	25,202	4·7	5,873	7,067	+1,194
	Total Gujerat	38·7	10·7	31·0	2,702,099	—396,098	431,586	4,316,014	3,572,209	1·32	1,259,530	2,554,419	121,403	159 945	246,046	6·9	31,175	39,071	+7,896
6	Khandesh	26·7	10·2	24·0	1,427,382	—7,420	333,955	3,200,264	3,037,620	2·13	2,560,972	2,784,072	51,124	68.425	75,277	2·5	17,097	26,824	+9,727
7	Nasik	43·7	17·9	46 4	816,504	—26,992	152,954	2 358,063	1,932.734	2 37	1,203,982	1 682,809	101,246	100,738	86,514	4 5	14,218	21,391	+7,173
8	Ahmadnagar	22·9	13·0	15·8	837,695	—51,060	54,578	3,111.673	2.649,834	3·16	2,259,408	2 260,142	116,825	126,896	120,543	4·5	22,278	30.726	+8.448
9	Poona	38·6	19·4	41 5	995,330	—72 470	10.986	2.487,065	2,036,865	2·05	1,624,790	1,564,591	135,222	141.299	102 828	5 0	17.780	22,377	+4,597
10	Sholapur	26·6	15·4	16·2	720 977	—28,865	15,254	2.463,665	1,967,911	2·73	1 956,015	1,625,133	123 233	131,930	135,830	6·9	16,432	21,234	+4,802
11	Satara	49·7	25·2	52·0	1.146,559	—78,631	22.691	2,132 094	1.724 642	1·50	1,511,072	1,625,133	142,623	142.776	114,099	6·6	19,206	26,745	+7,539
	Total Deccan	34·7	16 8	32·6	5,944,447	—265,438	590,418	15,752,824	13,349,606	2·25	11,116,239	11,541,880	670 273	712,064	635,091	4·8	107,011	149,297	+42,286
12	Belgaum	4 9	25·4	46 1	993,976	—19,285	68,126	2.126,661	1.717,886	1·73	1,682,774	1,570,179	51,687	55.463	53,214	3·1	8,560	12 516	+3,956
13	Bijapur	25·3	18·9	18·0	735,435	—60,904	64 375	3 162,833	2,371,944	3·23	2,487.195	2 603,491	16,701	21,780	18,617	0·8	4,901	7.191	+2,290
14	Dharwar	27·5	19·8	21·7	1,113,298	+62,086	68,868	2.343,619	2,068,766	1·86	1 945,046	2,033,961	87,058	78,630	57,597	2·8	4,413	4,592	+179
	Total Karnatak	19·2	21·4	28·6	2,842,709	—18 103	201,369	7,633 113	6,158,596	2·17	6,115,015	6,207,631	154,846	155,873	129,428	2·1	17,874	24,299	+6,425
	Total for Deccan and Karnatak	29·5	18·3	31·3	8,787,156	—283,541	791,787	23,385,937	19,508,202	2 22	17,231,254	17,749,511	825,119	867,937	764 519	3·9	124,885	173,596	+48,711
15	Thana	88·9	38·5	86·6	811.433	—8,147	114.629	937,324	465,671	·57	376,692	439,465	5,675	5,392	5.124	1·1	4,045	4,760	+715
16	Kolaba	128·9	58·2	133·7	605.566	+10,694	31,650	719.432	401,418	·67	371,156	439.465	2 281	2,104	1 586	0·4	1 303	1 513	+210
17	Ratnagiri	124·8	63·9	115·0	1,167,927	+62,001	6,786	284.522	130,409	·11	122,124	131.424	6,741	8,607	8,817	6·8	4.485	5,855	+1,370
18	Kanara	106·7	67·6	119·9	454,490	+8,037	51,004	336,646	246,565	·54	237,740	245,015	23,158	20,736	19,737	8·0	12,188	17,149	+4,961
	Total Konkan	112·6	55·6	113·8	3,039 416	+72,585	204,060	2.277,924	1,247.063	·41	1,107,712	1,255,369	37,855	36,839	35,264	2 8	22,021	29,277	+7,256
	Total Bombay Proper	50·5	24·8	49·5	14,528,671	—607,054	1,427,433	29,979,875	24,327,474	1·59	19,598,496	21,559.299	984,377	1,064,721	1,045.829	4·3	178,081	241,944	+63,863
	Total Sind	5·9	0·7	4·5	3,210,910	+339,136	6 668,831	8,000,942	3,322,933	1·03	2 996,458	4,020,866	2,837,975	2,964,428	2,857,069	86·0	10,731	12,419	+1,688
	Grand Total, Bombay Presidency	56·4	25·5	54·0	17,739,581	—267,918	8,096,264	37,980,817	27,650,407	1·49	22,594.984	25,580,165	3,822,352	22.029,149	3,902,898	14·12	188,812	254,363	+65,551

NOTE.—The population of Bombay City (776,006) included in the total population for calculating normal sown area per head of population (column 11).

BOMBAY PRESIDENCY.

Statement II.—Showing gross areas irrigated from different sources in each district.

Serial No.	Name of District.	1896-97.								1899-1900.								1900-1901.								Irrigation Wells in use during 1901-1902.		
		State works.								State works.								State works.										
		1st class.		2nd class (chiefly storage).	Total.	Private canals.	Wells.	Other sources.	Total.	1st class.		2nd class (chiefly storage).	Total.	Private canals.	Wells.	Other sources.	Total.	1st class.		2nd class (chiefly storage).	Total.	Private canals.	Wells.	Other sources.	Total.	Masonry.	Unsteined.	Total.
		Canals.	Storage works.							Canals.	Storage works.							Canals.	Storage works.									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.			
1	Ahmadabad	6,826	.	10,772	17,598	...	46,342	2,930	66,870	110	...	10,783	10,893		101,814	4,007	116,714	3,849		...	3,849	...	39,606	1,910	45,365	12,678	4,184	16,862
2	Kaira	...	.	7,349	7,349	...	47,056	3,248	57,653	...	...	8,567	8,567	...	76,567	5,083	90,217	..		8,557	8,557	7	35,939	668	45,171	9,848	1,298	11,146
3	Panch Mahals	...	...	...	..	32	2,100	..	2,132		.	25	25	...	7,417	317	7,759	...	..	162	162	.	3,350	60	3,572	977	1,839	2,816
4	Broach	...	...	905	905	...	786	...	1,691	...	..	885	885	.	5,267	2	6,154	..	.	1,010	1,010	...	672	1	1,683	1,066	114	1,180
5	Surat	...	...	12 375	12,375	..	7,248	258	19,881	.	..	12,288	12,288	...	12,787	127	25,202		...	12 278	12,278	90	7,309	154	19,841	6,490	577	7,067
	Total Gujerat	6,826	...	31,401	38,227	32	103,532	6,436	148,227	110		32,548	32,658	.	203,852	9,536	246,046	3,849	...	22,007	25,856	97	86,876	2,803	115,632	31,059	8,012	39,071
6	Khandesh	4,980	4,761	9,102	18,843	2,000	50,336	802	71,981	4,515	3,361	8,477	16,353	1,055	53,577	4,292	75,277	3,757	3,116	9,053	15,926	1,579	45,114	1,259	63,878	22,053	4,771	26,824
7	Nasik	3,403	822	28,404	32,629	...	74,068	22,996	129,693	2,520	172	27,879	30,571	151	54,563	7,229	86,514	3,020	743	27,482	31,245	884	39,170	11,494	82,793	14,587	6,804	21,391
8	Ahmadnagar	6,564	1,386	147	8,097	..	161,294	17,592	186,983	4,754	870	147	5,771	.	111,790	2,932	120,543	8,362	1,039	..	9,401	.	65,568	1,719	76,688	25,890	4,836	30,726
9	Poona	42,553	10 384	515	53,452	10,642	100,146	6,582	170,822	27,200	11,162	481	38,843	788	58,635	4,562	102,828	51,728	13,382	481	65,591	2,724	50,578	3,679	122,572	16,963	5,414	22,377
10	Sholapur	...	13,713	...	13,713	...	122,526	2,714	138,953	...	24,089	.	24,089	208	106,731	4,802	135,830	.	8,219	...	8,219	61	98,357	4,433	111,070	7,584	13,650	21,234
11	Satara	9,067	6,815	103	15,985	...	86 173	75,611	177,769	6,718	8,801	110	15,629		74,234	24,236	114,099	9,541	6,296	110	15,947	.	74,629	34,724	125,300	9,741	17,004	26,745
	Total Deccan	66,567	37,911	38,271	142,749	12,642	594,543	125,297	876,231	45,707	48,455	37,094	131,256	2,202	419,530	[illegible] ,103	635,091	76,408	32,795	37 126	146,329	5,248	373,416	57,308	582,301	96,816	52,479	149,297
12	Belgaum	5,565	337	9,910	15,812	...	30,644	7,067	53,523	8,424	337	9,910	18,671	.	29,326	5,217	53,214	10,509	337	9,910	20,755	...	23,351	2,178	46,284	2,164	10,352	12,516
13	Bijapur	...	10	1,440	1,450	389	25,760	4,329	31,928	.	64	1,440	1,504	1,254	15,239	620	18,617		77	1,437	1,514	1,177	17,218	978	20,887	1,382	5,809	7,191
14	Dharwar	...	1,454	62,455	63,909	...	3,847	25,179	92,935	.	2,193	49,567	51,760	.	3,340	2,497	57,597	.	1,703	53,798	55,501	81	4,927	20,611	81,120	1,538	3,054	4,592
	Total Karnatak	5,565	1,801	73,805	81,171	389	60,251	36,575	178,386	8,424	2,594	60,917	71,935	1,254	47,905	8,334	129,428	10,508	2,117	65,145	77,770	1,258	55,496	23,767	148,291	5,084	19,215	24,299
	Total for Deccan and Karnatak	72,132	39,712	112,076	223,920	13,031	654,794	161,872	1,054,617	54,131	51,049	98,011	203,191	3,456	467,435	90,437	764,519	86,915	34,912	102,271	224,099	6,506	428,912	81,075	730,592	101,902	71 694	173,596
15	Thana	...	...	...	...	...	5,172	..	5,172	...			..	..	2,504	2,620	5,124	.			..		2,281	2,938	5,219	2,364	2,396	4,760
16	Kolaba	...	...	..	..	...	1,921	297	2,218	...	.	...	..	.	1,302	284	1,586	.	..	.	...	.	1,730	285	2,015	1,142	371	1,513
17	Ratnagiri	.	.	1,349	1,349	...	3,399	2,946	7,694	.		1,349	1,349	70	2,948	4,450	8,817	.	...	1,349	1,349	71	3,281	4 024	8,725	2,545	3,310	5,855
18	Kanara	...	540	...	540	374	7,285	17,477	20,676	.	540	.	540	1,487	1,620	16,090	19,737	..	540	..	540	1,818	1,698	16,461	20,517	7,139	10,010	17,149
	Total Konkan	...	540	1,349	1,889	374	12,777	20,720	35,760	.	540	1,349	1,889	1,557	8,374	23,444	35,264	...	540	1,349	1,889	1,889	8,990	23,708	36,476	13,190	16,087	29,277
	Total Bombay Proper	78,958	40,252	144,826	264,036	13,437	771,103	190,028	1,238,604	54,241	51,589	131,908	237,738	5,013	719,661	83,417	1,045,829	90,765	35,452	125 627	251,844	8,492	524,778	107,586	892,700	146,151	95,793	241,944
	Total Sind	2,650,755	...	...	2,650,755	.	34,051	96,401	2,781,207	2,771,902	..	...	2,771,902	...	41,005	110,414	2,923,321	3,321,906			3,321,906	...	13,926	130,447	3,466,279	..	..	12,419
	Grand Total Bombay Presidency	2,729,713	40,252	144,826	2,914,791	13,437	805,154	286,429	4,019,811	2,826 143	51,589	131,908	3 009,640	5,013	760,166	193,831	3,969,150	3,412,671	35,452	125,627	3,573,750	8,492	538,704	238,033	4,358,979	146,151	95,733	254,363

MADRAS PRESIDENCY.

Statement I.—Showing present condition of districts with reference to Population, Cultivation, and Irrigation.

Serial No.	Name of Districts.	RAYATWARI (INCLUDING MINOR INAM).											ZAMINDARI AND PROPRIETARY AND INAM VILLAGES.			
		Annual rainfall in inches.		Population.		Area culturable but not cultivated.	Average area under cultivation, including current fallows, for five years ending 1900-01.	Gross area of crops sown.			Area irrigated in 1900-01.	Percentage on average area of crops sown (column 10) of area irrigated in 1900-01 (column 12).	Population.		Area annually under crop (estimated).	Area annually irrigated.
		Average of 30 years	In 1900-01.	In 1901	Increase since 1891.			In 1900-01	Average for five years ending 1900-01.	Average per head of population (columns 5 and 10).			In 1901.	+ or — since 1891.		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
						Acres.	Acres.	Acres.	Acres.	Acres.	Acres.				Acres.	Acres.
1	Ganjam	45·46	52·19	616,595	30,002	64,800	457,300	517,600	482,500	0·78	238,591	49·4	1,072,547	+88,816	1,100,000	495,000
2	Vizagapatam	41·32	33·68	243,076	16,827	24,700	221,000	263,300	248,900	1·02	144,504	58·1	1,839,586	+122,624	1,800,000	540,000
3	Godavari	38·73	37·12	1,305,597	98,212	185,900	1,356,600	1,275,700	1,179,600	0·90	707,046	59·9	836,320	+113,032	780,000	275,000
4	Kistna	33·08	32·01	1,620,597	226,053	327,600	2,502,900	2,350,900	2,207,500	1·36	455,567	20·6	534,206	+75,313	700,000	175,000
5	Kurnool	26·36	23·18	851,384	54,670	359,900	2,017,100	1,953,300	1,849,800	2·17	133,798	7·2	52,935	—3,658	124,000	8,500
6	Bellary	22·63	22·59	969,938	45,152	406,800	2,291,500	2,166,900	2,079,200	2·26	83,464	4·0	38,476	+2,172	92,000	3,500
7	Anantapur	22·81	23·59	762,258	79,313	829,600	1,735,200	1,498,000	1,435,700	1·88	204,799	14·3	25,996	+1,298	45,000	5,500
8	Cuddapah	27·84	24·38	1,234,763	23,176	441,100	1,823,500	1,652,500	1,646,700	1·33	432,297	26·3	56,504	—6,255	62,000	14,000
9	Nellore	34·00	28·27	908,694	55,648	263,600	1,417,200	1,157,700	1,119,600	1·23	352,752	31·5	588,293	—22,397	1,020,000	227,000
10	Chingleput	45·04	34·14	951,357	107,968	72,000	720,700	647,300	677,900	1·71	441,096	65·1	360,765	+15,719	270,000	162,000
11	South Arcot	43·20	45·30	2,253,323	178,845	312,600	1,641,200	1,722,400	1,652,700	0·73	614,971	37·2	96,571	+8,198	72,000	21,000
12	North Arcot	37·08	30·53	1,403,268	47,094	318,300	988,700	945,600	962,300	0·69	551,365	57·3	804,449	+51,385	800,000	250,000
13	Salem	31·85	30·19	1,483,955	106,761	349,100	1,437,600	1,476,300	1,416,900	0·98	333,918	23·1	721,019	+139,917	570,000	114,000
14	Coimbatore	25·82	27·12	2,123,423	192,398	247,600	2,755,000	2,541,600	2,516,100	1·18	559,548	22·2	78,329	+4,515	100,000	20,000
15	Trichinopoly	34·20	33·97	1,158,685	63,753	192,100	1,149,700	981,100	962,600	0·83	297,028	30·8	666,525	+15,644	585,000	146,000
16	Tanjore	44·40	49·54	1,806,881	61,918	64,100	1,222,200	1,171,600	1,152,900	0·64	886,342	77·7	438,148	—44,929	333,000	170,006
17	Madura	30·19	37·25	1,233,845	119,890	197,100	1,149,200	1,068,100	1,056,900	0·86	386,841	36·6	1,597,435	+123,639	1,700,000	510,000
18	Tinnevelly	26·80	38·62	1,470,340	121,993	55,800	1,532,000	1,322,800	1,277,100	0·87	463,790	36·3	589,267	+21,519	630,000	60,000
19	The Nilgiris	63·91	94·03	111,437	11,640	54,900	197,300	70,800	72,100	0·65	...	...	...	...	...	...
20	Malabar	114·39	128·88	2,790,281	167,875	1,170,800	1,028,700	1,173,100	1,189,500	0·43	38,316	3·2	...	...	...	...
21	South Canara	143·32	155·49	1,134,713	78,632	165,400	457,700	588,400	574,200	0·51	...	...	...	...	...	...
	TOTAL	...	...	26,384,405	1,887,820	6,102,800	28,102,300	26,545,000	25,790,700	0·98	7,336,033	28·4	10,397,371	+706,852	10,783,000	3,196,500

MADRAS PRESIDENCY.

Statement II.—Showing gross areas irrigated from different sources in each district in 1900-01.

Serial No.	District.	STATE WORKS.				PRIVATE WORKS.							Grand Total.	NUMBER OF WELLS.		RAYATWARI.
		(RAYATWARI AND ZAMINDARI).				RAYATWARI.					Zamindari and proprietary and inam.	Total.		Ayakat.	Supplemental.	Number of tanks.
		Canals.	Tanks.	Other sources.	Total.	Canals.	Tanks.	Wells.	Other sources.	Total.						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.			
1	Ganjam	134,785	107,341	28,191	270,317	...	733	1,073	240	2,046	461,228	463,274	733,591	1,208	131	2,607
2	Vizagapatam	44,768	108,933	4,753	158,454	15	605	...	134	754	525,296	526,050	684,504	...	...	1,522
3	Godavari	835,874	91,769	915	928,558	...	265	1,764	29	2,058	51,430	53,488	982,046	1,500	...	1,510
4	Kistna	562,517	36,943	4,550	604,010	...	627	11,504	1,875	14,006	12,551	26,557	630,567	5,031	24	433
5	Kurnool	34,225	47,509	12,586	94,320	223	814	38,450	6	39,493	8,485	47,978	142,298	7,211	589	545
6	Bellary	22,445	33,319	3,426	59,190	...	343	23,884	47	24,274	3,500	27,774	86,964	7,588	462	388
7	Anantapur	36,705	87,249	16,556	140,510	460	874	62,764	191	64,289	5,500	69,789	210,299	14,248	2,999	842
8	Cuddapah	63,838	148,326	46,227	258,391	785	1,687	170,755	679	173,906	14,000	187,906	446,297	37,365	10,463	4,361
9	Nellore	138,833	128,620	13,561	281,014	...	6,488	72,834	1,380	80,702	218,036	298,738	579,752	16,192	929	782
10	Chingleput	22,743	344,268	22,171	389,182	...	836	57,812	...	58,648	155,266	213,914	603,096	13,700	16,569	2,553
11	South Arcot	138,245	327,945	31,903	498,093	6	1,551	117,820	122	119,499	18,379	137,878	635,971	68,265	24,687	3,243
12	North Arcot	63,332	257,981	27,008	348,321	7	2,659	202,124	1,816	206,606	246,438	453,044	801,365	65,478	45,728	3,158
13	Salem	29,350	158,876	9,410	197,636	319	970	134,768	309	136,366	113,916	250,282	447,918	48,800	23,252	2,291
14	Coimbatore	128,037	18,998	4,722	151,757	473	465	406,426	427	407,791	20,000	427,791	579,548	70,828	2,940	151
15	Trichinopoly	166,551	60,217	3,727	230,495	...	878	67,978	48	68,904	143,629	212,533	443,028	32,063	207	1,590
16	Tanjore	907,436	51,448	1,138	960,022	...	1,393	3,509	393	5,295	101,025	106,320	1,066,342	10,009	251	734
17	Madura	20,479	245,142	1,109	266,730	...	646	137,314	186	138,146	491,965	630,111	896,841	33,559	7,190	4,081
18	Tinnevelly	70,174	289,425	3,648	363,247	...	1,702	108,926	372	111,000	49,543	160,543	523,790	48,872	7,942	2,383
19	The Nilgiris	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20	Malabar	...	...	...	...	10,979	10,972	1,430	14,935	38,316	...	38,316	38,316	...	...	..
21	South Canara	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Total	3,420,337	2,544,309	235,601	6,200,247	13,267	34,508	1,621,135	23,189	1,692,099	2,640,187	4,332,286	10,532,533	481,917	144,363	33,174

Note.—Column 6 includes 556,313 acres irrigated in zamindaris by Government works. *Column 9* excludes the area irrigated by Government and Dasabandari wells, *viz.*, 42,324 acres, which is included in *column 5*. *Column 12* shows areas as estimated by the Deputy Director, Land Records and Agriculture, Madras. They include about 200,000 acres of well-irrigation, the balance being practically all tank irrigation.

CENTRAL PROVINCES.

Statement 1.—Showing the present condition of districts with reference to Population, Cultivation, and Irrigation.

1	2	3				4		5	6	7		8			9		
		ANNUAL RAINFALL.				POPULATION.				GROSS AREA OF CROPS SOWN.		GROSS AREA IRRIGATED IN			PERCENTAGE OF GROSS AREA IRRIGATED ON NORMAL AREA SOWN.		
Serial No.	NAME OF DISTRICT.	Average.	1895	1896.	1899.	In 1901.	+ or — since 1891.	Area cultivable but not cultivated.	Cultivated area.	In a normal year (1895 96).	Average per head of population.	1895-96.	1896-97.	1899-1900.	Normal year 1895-96.	Early cessation of rains 1896-97.	Year of drought 1899-1900.
		Inches.	Inches.	Inches.	Inches.			Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.			
1	Saugor	44·9	38·8	34·1	24·5	471,046	−120,697	1,030,710	869,053	901,232	1·9	6,300	6,521	6,582	0·7	0·6	0·6
2	Damoh	46·7	37·7	49·9	30·3	285,326	−41,287	538,447	522,043	492,567	1·7	2,188	2,020	1,972	0·4	0·0	0·3
3	Jubbulpore	49·0	43·9	58·8	29·6	680,585	−67,561	683,880	1,224,469	954,447	1·4	3,086	3,199	3,137	0·3	0·3	0·3
4	Mandla	52·1	41·6	51·9	26·6	317,250	−22,123	1,022,749	700,915	626,910	2·0	1,078	1,034	809	0·2	0·2	0·1
5	Seoni	50·9	37·8	47·1	24·4	327,709	−43,058	652,906	828,042	680,287	2·0	27,615	21,077	2,492	4·2	2·9	0·3
	TOTAL	48·7	40·5	48·4	27·1	2,081,916	−293,726	3,935,691	4,144,212	3,645,443	1·8	40,327	33,851	14,992	1·1	0·8	0·4
6	Narsinghpur	51·2	49·3	58·0	24·6	313,951	−53,075	372,194	619,472	619,152	2·0	2,973	3,566	2,666	0·5	0·5	0·4
7	Hoshangabad	54·4	46·3	55·8	29·0	449,165	−83,780	595,977	971,298	1,021,099	2·3	3,517	3,998	4,110	0·3	0·4	0·4
9	Nimar	32·1	22·1	31·8	11·9	327,035	+73,549	541,231	690,619	524,128	1·6	12,202	11,011	5,839	2·2	2·1	1·0
9	Betul	42·2	34·5	39·8	15·9	285,363	−37,843	580,385	854,606	651,457	2·3	8,127	12,056	6,777	1·2	1·8	1·0
10	Chhindwara	39·3	33·4	33·9	14·4	407,927	+433	350,136	887,970	700,289	1·7	7,853	9,282	6,702	1·1	1·3	0·9
	TOTAL	43·6	35·1	43·1	19·1	1,783,441	−97,708	2,4 8,823	4,063,043	3,517,225	2·0	34,062	39,913	25,564	1·0	1·1	0·7
11	Wardha	39·8	42·1	38·9	14·1	385,103	−15,751	234,153	1,016,382	875,042	2·3	2,840	3,957	2,589	0·3	0·4	0·3
12	Nagpur	45·9	51·3	46·4	15·5	751,844	−6,018	520,411	1,374,783	1,202,370	1·6	23,831	24,124	10,307	2·0	1·9	0·8
13	Chanda	50·9	52·9	54·5	21·4	601,533	−96,077	1,677,376	983,552	704,541	1·2	147,496	159,472	26,554	20·9	23·1	3·8
14	Bhandara	53·9	48·7	60·2	15·4	663,062	−79,788	949,640	989,878	974,543	1·5	240,364	216,467	45,178	25·3	20·0	4·2
15	Balaghat	61·1	57·3	54·0	29·7	326,521	−56,810	590,855	469,743	531,084	1·6	98,358	58,539	16,190	18·5	10·1	2·8
	TOTAL	50·3	50·5	52·6	21·2	2,728,083	−254,444	3,981,065	4,831,137	4,287,465	1·6	518,797	482,559	100,816	12·1	10·3	2·2
16	Raipur	47·6	51·2	62·9	33·0	1,440,556	−143,871	1,091,943	3,009,110	2,813,017	2·0	37,102	63,408	26,227	1·3	2·0	0·8
17	Bilaspur	51·2	47·0	60·9	25·8	1,012,972	−151,188	1,789,001	1,845,658	1,722,833	1·7	54,238	79,574	23,316	3·1	4·5	1·3
8	Sambalpur	57·6	61·3	80·9	40·4	829,698	+33,285	672,558	1,402,172	828,108	1·0	82,697	111,271	64,349	20·0	18·4	10·7
	TOTAL	52·1	52·8	68·2	30·4	3,283,228	−261,772	4,353,5 2	6,258,940	5,303,958	1·6	174,035	254,253	113,892	3·2	4·6	2·1
	GRAND TOTAL	48·3	43·8	51·4	24·8	9,876,646	−9 7,648	14,7 9,981	19,205,332	16,814,091	1·7	767,821	790,576	255,264	4·6	4·4	1·4

CENTRAL PROVINCES.

Statement II.—Showing gross areas irrigated from different sources in each district.

Serial No.	Name of District.	GROSS AREA IRRIGATED.																		Number of irrigation wells in use during 1900-1901.			Number of irrigation tanks in use during 1900-1901.
		AVERAGE OF FIVE YEARS ENDING 1900-01.						DURING THE YEAR 1895-96.						DURING THE YEAR 1899-1900.									
		Canals.		Tanks	Wells.	Other sources.	Total.	Canals.		Tanks.	Wells.	Other sources.	Total.	Canals.		Tanks.	Wells.	Other sources.	Total.				
		State.	Private.					State.	Private.					State.	Private.								
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Temporary	Durable.	Total.	
1	Saugor	..	..	124	5,899	450	6,473	..	...	228	5,688	434	6,350	...	..	88	5,941	553	6,582	1,681	1,656	3,337	12
2	Damoh	..	...	95	1,510	369	1,974	...	...	166	1,631	391	2,188	...		22	1,520	430	1,972	294	695	989	14
3	Jubbulpore	...		81	2,433	399	2,913	...	...	78	2,555	463	3,096	...	...	51	2,508	578	3,137	1,328	1,097	2,425	27
4	Mandla		.	21	483	463	967	...	.	50	444	584	1,078	..	...	30	326	453	809	281	40	321	2
5	Seoni	...	...	14,636	859	722	16,227	...	..	26,015	442	1,158	27,615	...	...	1,190	711	591	2,492	933	340	1,273	656
	TOTAL	..	...	14,957	11,194	2,413	28,554	.	...	26,537	10,760	3,030	40,327	...	..	1,381	11,006	2,605	14,992	4,517	3,828	8,345	711
6	Narsinghpur	...		2	2,587	315	2,904	.	...	1	2,525	447	2,973	...	...	1	2,475	230	2,706	875	539	1,414	1
7	Hoshangabad	..		3	3,342	451	3,785	..	...	...	2,915	592	3,507	...	..	...	3,668	442	4,110	1,073	747	1,820	1
8	Nimar	..	...	115	11,038	658	11,811	...	...	102	11,315	725	12,142	...	...	...	5,226	43	5,269	2,513	1,806	4,319	3
9	Betul	...		...	8,288	906	9,194	..	..	..	8,087	40	8,127	...	...	...	6,700	77	6,777	3,202	2,145	5,347	...
10	Chhindwara	..	..	56	7,543	650	8,279	..	...	2	7,583	268	7,853	...	.	..	6,579	123	6,702	4,052	422	4,474	8
	TOTAL	..	...	179	32,728	2,079	35,686	.	..	105	32,425	2,072	34,602		...	1	24,648	915	25,564	11,715	5,659	17,374	13
11	Wardha	..	...	13	3,184	20	3,217	...	.	51	2,768	1	2,819	...	.	.	2,536	3	2,539	1,405	885	2,290	1
12	Nagpur	...	..	10,735	10,328	71	21,134	..	..	13,340	10,475	26	23,841	.	...	372	9,875	60	10,307	4,877	1,255	6,132	1,153
13	Chanda	.	.	111,596	2,368	2,617	116,781	..	...	142,687	2,778	1,941	147,406	.	...	22,315	2,206	2,033	26,554	1,695	345	2,040	5,358
14	Bhandara	.	..	169,348	2,593	2,014	173,955	...	...	242,267	2,216	1,881	246,364	..	..	42,502	2,328	346	45,176	802	511	1,313	13,561
15	Balaghat	..	.	42,345	2,525	1,124	45,994	...	...	93,016	3,580	1,311	[illegible]	.	...	13,047	2,227	910	16,184	2,839	778	3,617	2,431
	TOTAL	...		334,027	20,998	6,656	361,079	...	...	491,391	22,246	5,160	518,797	...	...	78,236	19,222	3,358	100,816	11,618	3,774	15,392	22,504
16	Raipur	...	4,377	22,010	5,977	2,934	35,298	..	333	29,039	4,582	3,148	37,102	...	810	19,219	3,506	2,692	26,227	4,033	185	4,218	1,620
17	Bilaspur	...	...	14,866	859	6,748	22,473	...	...	51,312	1,037	1,887	54,236	...	...	20,251	880	2,085	23,216	1,177	207	1,384	6,580
18	Sambalpur	...	...	44,351	3,077	1,900	49,657	..	..	78,100	2,015	2,582	82,697	..	...	57,099	4,926	2,424	64,449	8,634	351	8,985	8,810
	TOTAL	...	4,377	81,227	9,913	11,881	107,428	.	333	158,451	7,634	7,617	174,035	...	810	96,569	9,312	7,201	113,892	13,844	743	14,587	17,010
	GRAND TOTAL	...	4,377	430,390	74,851	23,029	532,947	...	333	676,544	73,065	17,879	767,821	...	810	176,187	61,188	14,079	255,264	41,694	14,004	55,698	40,238

BENGAL.

Statement showing present condition of districts with reference to Population, Cultivation, and Irrigation.

Serial No.	Name of District.	Average annual rainfall	POPULATION		Area cultivable but not cultivated.	Cultivated or occupied area.	Average gross area annually under crop.	Average per head of population.	AVERAGE AREA IRRIGATED ANNUALLY.					REMARKS.
			In 1901.	+ or — since 1891.					State works.	Private works.	Wells.	Other private sources.	Grand Total.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Acres.	Acres.	Acres.		Acres.	Acres.	Acres	Acres.	Acres.	
1	Burdwan	56·1	1,532,475	+ 140,595	208,000	1,166,005	1,280,800	0·8	19,358	...	...	128,080	147,438	
2	Bankura	55·3	1,116,411	+ 46,743	831,000	675,616	623,660	0·6	...	...	..	200,000	200,000	
3	Birbhoom	59·2	902,280	+ 104,026	90,000	895,000	792,780	0·9	...	...	...	195,000	195,000	
4	Midnapur	59·9	2,789,114	+ 157,648	200,000	2,212,175	2,225,880	0·8	79,240	...	...	8,698	87,938	
5	Hooghly	59·0	1,049,282	+ 14,986	120,000	568,225	556,620	0·5	8,509	...	...	...	8,509	
	Total Burdwan Division	57·9	7,389,562	+ 463,998	1,449,000	5,517,021	5,479,740	0·7	107,107	...	...	531,778	638,885	
6	Twenty-four Parganas	63·1	2,078,359	+ 186,326	378,658	1,081,702	1,018,900	0·5	...	...	...	...	...	
7	Khulna	65·9	1,253,043	+ 75,391	306,200	965,457	985,120	0·8	...	...	...	...	...	
8	Nadia	57·2	1,667,491	+ 23,383	348,000	1,115,000	1,048,120	0·6	...	...	...	...	...	
9	Jessore	60·7	1,813,155	— 75,672	112,800	1,002,343	1,279,160	0·7	...	..	...	...	...	
10	Murshidabad	54·1	1,333,184	+ 82,238	200,000	1,005,012	1,118,840	0·8	...	...	...	...	...	
	Total Presidency Division	60·2	8,145,232	+ 291,666	1,345,653	5,259,514	5,450,140	0·7	...	...	...	...	...	
11	Dinajpur	69·9	1,567,080	+ 84,510	415,000	1,544,165	1,472,060	0·9	...	...	...	...	...	
12	Rajshahi	57·1	1,462,407	+ 22,773	58,642	1,107,777	1,401,180	1·0	...	..	...	14,000	14,000	
13	Rungpur	78·8	2,154,181	+ 88,717	300,000	1,358,350	2,009,440	0·9	...	...	...	...	...	
14	Bogra	66·5	854,533	+ 90,072	98,446	662,973	775,420	1·0	...	...	..	...	...	
15	Pabna	61·4	1,420,461	+ 59,238	75,460	885,940	1,526,500	1·1	...	...	...	...	..	
16	Darjeeling	132·5	249,117	+ 25,803	50,000	169,169	184,007	0·7	...	...	...	...	...	
17	Jalpaiguri	124·9	787,380	+ 106,644	258,000	1,035,861	1,002,410	1·3	...	...	...	...	...	
	Total Rajshahi Division	84·4	8,495,159	+ 477,757	1,255,548	6,764,235	8,371,047	1·0	...	...	...	14,000	14,000	
18	Dacca	71·1	2,649,522	+ 254,092	86,100	1,159,015	1,397,440	0·5	...	..	...	Less than 5,000	Less than 5,000	
19	Faridpur	65·4	1,937,616	+ 113,931	75,000	1,281,295	1,399,880	0·7	...	...	.	..	..	
20	Backerganj	85·1	2,291,752	+ 137,787	150,000	1,513,600	1,752,040	0·8	...	...	...	...	...	
21	Maimensingh	86·6	3,915,068	+ 442,882	379,800	3,030,735	3,057,520	0·8	..	...	...	...	...	
	Total Dacca Division	77·0	10,793,988	+ 948,692	690,900	6,984,615	7,606,880	0·7	...	...	...	5,000	5,000	
22	Tippera	75·6	2,117,991	+ 335,056	89,000	1,298,590	1,614,960	0·8	...	...	...	...	...	
23	Noakhali	113·0	1,141,728	+ 132,035	30,000	919,782	948,840	0·8	...	...	...	...	...	
24	Chittagong	111·8	1,478,012	+ 80,559	193,574	629,504	627,080	0·4	..	..	...	8,591	8,591	
	Total Chittagong Division	100·1	4,737,731	+ 547,650	312,574	2,847,876	3,190,880	0·7	...	...	...	8,591	8,591	
25	Patna	45·2	1,624,985	— 148,425	108,200	1,018,300	1,125,400	0·7	38,151	..	38,000	298,000	374,151	
26	Gya	48·0	2,050,933	— 78,398	158,000	2,188,460	2,145,660	1·0	52,115	..	100,000	1,564,413	1,716,528	
27	Shahabad	43·5	1,962,696	— 97,883	200,000	1,986,815	1,793,140	0·9	342,147	...	233,184	600,000	1,175,331	
28	Darbhanga	49·8	2,912,611	+ 110,656	198,600	1,782,440	2,566,800	0·9	...	..	6,666	102,725	109,391	
29	Muzaffarpur	45·9	2,754,790	+ 41,933	108,859	1,559,026	2,277,960	0·8	...	.	18,823	11,005	29,828	
30	Saran	44·9	2,409,509	— 55,498	113,687	1,382,168	1,767,120	0·7	...	..	139,462	54,962	194,424	
31	Champaran	54·1	1,790,463	— 69,002	387,700	1,551,801	1,990,440	1·1		...	1,412	26,294	27,706	
	Total Patna Division	46·6	15,514,987	— 206,617	1,275,046	11,472,010	13,666,520	0·9	432,413	...	537,547	2,657,399	3,627,359	
32	Monghyr	49·0	2,068,804	+ 32,783	170,000	1,511,595	2,079,400	1·0	..	...	53,900	147,454	201,354	
33	Bhagalpur	51·2	2,088,953	+ 56,257	200,000	2,284,280	2,786,300	1·3	..	..	65,000	717,500	782,500	
34	Purnea	72·5	1,874,794	— 69,864	679,965	2,043,555	1,887,500	1·0	...	.	100	2,000	2,100	
35	Malda	56·8	884,030	+ 69,111	332,000	716,400	858,720	1·0	...	...	...	34,000	34,000	
36	Sonthal Parganas	53·8	1,809,737	+ 55,962	722,631	1,704,317	1,349,380	0·7	.	...	...	77,260	77,260	
	Total Bhagalpur Division	56·7	8,726,318	+ 144,240	2,104,596	8,260,147	8,961,300	1·0	...	...	119,000	978,214	1,097,214	
37	Cuttack	60·4	2,062,758	+ 125,057	138,200	1,200,469	1,368,380	0·7	170,787	...	...	60,000	230,787	
38	Balasore	61·0	1,071,197	+ 76,522	140,000	738,823	798,500	0·7	32,753	...	...	...	32,753	
39	Angul	55·3	191,911	+ 21,853	240,000	292,584	250,300	1·3	..	...	...	10,000	10,000	
40	Puri	56·6	1,017,284	+ 72,286	180,588	768,071	735,920	0·7	..	..	...	...	...	
	Total Orissa Division	58·3	4,343,150	+ 295,748	698,788	2,999,447	3,153,100	0·7	203,540	...	...	7 0,00	273,540	
41	Hazaribagh	51·9	1,177,961	+ 13,640	600,000	2,259,883	2,062,580	1·8	...	...	...	231,400	231,400	
42	Ranchi	56·8	1,187,925	+ 59,040	600,000	3,210,587	2,874,800	2·4	..	...	...	..	...	
43	Palamau	48·1	619,600	+ 22,830	680,010	670,014	598,100	1·0	..	...	4,851	94,254	99,105	
44	Manbhum	52·2	1,301,364	+ 108,036	135,998	1,422,397	1,381,020	1·1	.	..	...	300,000	300,000	
45	Singhbhum	58·3	613,579	+ 68,091	628,490	880,826	868,920	1·4	...	..	...	54,000	54,000	
	Total Chota Nagpur Division	53·5	4,900,429	+ 271,637	2,639,498	8,443,707	7,785,420	1·6	...	...	4,851	679,654	684,505	
	Total Bengal	64·6	78,046,556	+ 3,144,780	11,771,608	58,548,602	63,665,027	0·9	743,060	..	661,398	4,944,636	6,349,094	

NOTE.—The population of *Calcutta* and *Howrah* towns included in the total population of the Province for calculating average gross area under crop per head of population (column 9.)

UNITED PROVINCES OF AGRA AND OUDH.

Statement I.—Showing present condition of districts with reference to Population, Cultivation, and Irrigation.

Serial No.	District.	Annual and Winter Rainfall.								Population.		Area culti-vable but not cultivated.	Cultivated area including cur-rent fallows.	Gross area annually sown.		Gross areas irrigated.		
		Average.		1896-97.		1897-98.		1899-1900.		In 1901.	+ or − since 1891.			Normal.	Per head of population.	1896-97.	1897-98.	1899-1900.
		Annual.	Winter.	Annual 1896	Winter 1896-97.	Annual 1897.	Winter 1897-98.	Annual 1899.	Winter 1899-1900.									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
												Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
1	Dehra Dun	68·1	6·79	76·31	5·78	72·50	6·09	61·1	7·51	178,195	+10,060	88,173	106,341	128,441	0·7	34,067	37,458	38,124
2	Bijnor	43·5	4·04	37·06	1·41	36·63	4·71	25·4	3·22	779,951	−14,119	228,129	734,404	717,414	0·9	56,813	46,538	64,861
3	Naini Tal	65·7	11·06	77·55	7·75	121·16	10·39	48·1	10·16	311,237	−231,475	186,174	291,437	319,577	1·2	123,027	124,480	144,085
4	Bareilly	47·1	3·07	26·48	1·52	56·04	4·75	33·4	4·73	1,090,117	+49,426	87,825	816,709	945,167	0·9	187,814	211,883	211,421
5	Pilibhit	51·5	3·87	42·01	2·68	74·02	5·81	38·7	5·20	470,339	−15,027	247,816	459,647	484,580	1·0	82,154	97,197	63,973
6	Kheri	45·7	2·82	36·66	1·83	36·43	3·22	42·7	2·66	906,138	+1,523	430,240	997,744	935,305	1·0	34,021	95,363	112,059
7	Bahraich	45·1	2·76	38·43	3·17	53·29	3·87	37·1	2·59	1,051,347	+50,915	360,234	982,888	1,203,025	1·1	62,814	75,795	80,547
8	Gonda	44·1	2·17	29·24	2·32	50·08	5·89	48·0	2·13	1,403,195	−56,034	332,390	1,223,769	1,511,302	1·1	194,833	224,486	232,778
9	Basti	48·8	1·95	26·93	2·66	54·37	2·02	54·9	3·92	1,846,153	+60,309	296,607	1,304,937	1,646,876	0·9	504,757	539,442	568,057
10	Gorakhpur	48·0	2·24	32·51	1·97	44·66	2·55	72·2	4·94	2,957,074	−36,983	403,108	2,160,159	2,629,265	0·9	546,303	606,146	744,381
	Total Tract 1	52·7	6·51	42·32	3·11	59·92	4·93	46·2	4·71	10,992,746	−181,405	2,660,696	9,080,855	10,560,952	1·0	1,826,603	2,057,783	2,300,336
11	Moradabad	39·9	3·74	24·80	0·97	48·92	5·01	26·6	5·93	1,191,993	+12,595	236,580	1,116,085	1,131,098	0·9	111,143	98,778	222,479
12	Budaon	33·9	2·39	21·38	1·26	39·67	3·92	28·2	3·05	1,025,753	+100,155	197,648	980,838	1,044,909	1·0	110,524	192,431	255,794
13	Shahjehanpur	37·3	2·58	28·78	1·31	45·52	5·40	28·0	1·92	921,535	+2,789	203,494	896,593	714,965	0·8	201,956	201,956	201,958
14	Hardoi	36·2	2·16	16·64	1·96	32·50	2·95	29·7	1·26	1,092,834	−20,377	322,958	968,468	995,987	0·9	212,882	259,525	262,729
15	Sitapur	37·8	2·40	29·24	1·63	30·98	3·85	37·8	1·53	1,175,473	+100,060	230,858	1,055,960	1,228,114	1·0	116,124	191,874	188,385
16	Lucknow	36·4	2·22	27·10	3·56	30·46	4·12	32·2	2·77	793,241	+19,078	116,035	378,671	434,147	0·5	121,992	123,839	142,634
17	Barabanki	39·5	2·21	18·31	3·09	30·49	1·89	35·9	2·37	1,179,323	+48,417	210,242	767,451	1,011,528	0·9	224,705	245,301	248,060
18	Fyzabad	42·5	2·10	29·09	3·05	38·55	1·28	53·7	3·29	1,225,374	+8,415	213,523	713,472	909,240	0·7	348,709	335,252	350,213
19	Azamgarh	41·0	1·75	12·83	2·10	50·56	1·60	51·0	5·00	1,529,785	−198,548	175,809	882,115	963,713	0·6	454,402	487,532	515,652
20	Ghazipur	39·5	1·98	26·66	1·95	47·88	1·98	46·1	3·71	913,818	−164,091	136,724	635,320	724,734	0·8	199,609	221,239	247,122
21	Ballia	41·4	...	...	...	...	...	56·7	...	987,768	+45,303	91,229	590,141	674,090	0·7	164,129	183,726	214,577
22	Unao	34·6	1·92	15·62	1·99	37·91	1·66	38·2	2·75	976,639	+23,003	242,128	660,732	745,459	0·8	220,431	237,432	262,949
23	Rai Bareli	37·5	1·63	15·89	1·74	45·73	1·80	44·6	2·46	1,033,761	−2,760	257,970	621,575	761,590	0·7	360,959	324,318	361,104
24	Sultanpur	42·8	1·73	21·73	2·52	40·96	1·49	45·6	3·57	1,083,904	+8,053	178,167	657,944	814,722	0·8	289,701	279,797	292,507
25	Partabgarh	38·0	1·82	22·39	1·67	46·75	1·80	47·4	3·08	912,848	+1,953	137,480	544,829	652,140	0·7	304,618	271,410	315,663
26	Jaunpur	42·2	1·72	21·04	0·69	47·50	1·57	43·1	5·05	1,202,920	−61,998	148,220	681,212	796,295	0·7	364,439	380,714	394,476
27	Benares	39·8	1·90	27·88	2·05	50·14	2·12	53·2	2·05	882,084	−39,859	71,454	436,745	466,946	0·6	139,959	154,573	162,383
	Total Tract 2	36·5	2·02	21·14	1·86	36·74	2·50	41·1	2·93	18,129,053	−118,102	3,170,619	12,481,151	14,069,677	0·8	3,946,252	4,188,717	4,638,693
28	Saharanpur	38·2	4·79	24·40	2·68	27·74	5·77	22·2	4·18	1,045,230	+43,950	131,629	904,611	1,041,590	1·0	220,877	197,441	262,0
29	Muzaffarnagar	30·3	3·75	26·42	1·15	27·86	3·74	18·4	1·76	877,188	+102,954	149,617	768,321	834,065	1·0	359,877	310,392	404,83
30	Meerut	27·4	3·25	21·88	1·09	27·08	5·74	19·8	1·66	1,540,175	+146,717	180,325	1,155,123	1,317,614	0·9	530,464	470,154	582,48
31	Bulandshahr	26·4	2·85	24·31	1·03	41·92	6·87	19·6	2·91	1,138,101	+168,187	179,122	911,690	1,091,132	1·0	468,771	462,366	589,72
32	Aligarh	26·0	2·13	20·29	1·10	30·54	2·07	19·3	1·35	1,200,822	+157,620	126,615	916,925	1,112,628	0·9	693,235	527,313	601,75
33	Muttra	24·4	1·55	14·17	0·58	29·94	4·02	16·2	0·51	763,099	+49,678	107,642	754,964	758,920	1·0	335,798	236,927	291,17
34	Agra	26·3	1·58	11·88	1·05	39·75	2·71	20·5	1·19	1,060,528	+56,732	136,111	828,444	849,899	0·8	359,597	231,967	308,54
35	Farrukhabad	32·7	1·81	15·63	1·50	49·06	3·84	30·4	1·44	925,812	+67,026	206,710	643,062	697,376	0·8	353,098	278,979	269,63
36	Mainpuri	31·6	1·81	15·38	0·96	31·74	3·35	21·5	2·39	829,357	+67,376	151,577	613,699	701,091	0·8	514,821	391,687	424,02
37	Etawah	32·0	1·62	12·22	0·79	30·71	2·78	27·8	0·69	806,798	+79,169	200,234	581,514	667,268	0·8	383,933	311,340	286,71
38	Etah	39·1	1·73	16·07	0·69	31·22	3·80	27·5	1·67	863,948	+161,855	188,661	706,065	806,029	0·9	437,514	344,095	379,80
39	Cawnpur	33·2	1·77	16·68	2·07	26·12	1·45	39·2	1·82	1,258,868	+49,173	256,874	848,745	916,609	0·8	426,501	381,141	316,47
40	Fatehpur	34·2	1·85	12·99	2·17	28·65	2·81	42·7	3·04	686,391	−15,766	186,871	583,674	605,415	0·9	144,944	184,319	208,04
	Total Tract 3	30·9	2·35	16·02	1·30	32·49	3·77	25·4	1·69	12,996,317	+1,156,701	2,274,978	10,236,777	11,424,630	0·9	5,248,720	4,328,121	4,915,27
41	Jhansi	36·5	1·64	31·89	2·33	26·64	2·00	26·8	1·19	616,759	−64,877	878,270	914,473	691,885	1·1	69,797	61,527	65,01
42	Jalaun	32·4	1·28	22·64	2·53	35·35	1·60	28·3	0·74	399,726	+3,365	205,087	667,186	533,207	1·3	94,393	64,453	44,83
43	Hamirpur	38·5	1·55	16·25	2·27	27·69	1·37	40·9	0·97	458,542	−55,178	422,499	804,583	643,143	1·4	22,819	20,611	21,39
44	Banda	40·5	1·72	17·50	2·02	36·17	0·92	41·5	1·25	631,058	−74,637	580,756	1,010,536	811,812	1·3	6,381	4,777	6,30
45	Allahabad	37·4	2·05	20·32	1·26	45·94	2·39	43·3	5·00	1,489,358	−59,379	294,169	1,137,254	1,206,376	0·8	257,340	256,347	273,42
46	Mirzapur	41·7	2·19	20·89	2·17	51·72	2·96	48·1	2·96	1,082,430	−68,060	518,307	718,496	621,912	0·6	47,548	80,279	102,25
	Total Tract 4	37·9	1·74	21·56	2·10	37·25	1·87	38·5	2·02	4,677,873	−318,966	2,899,088	5,152,528	4,508,335	1·0	498,268	480,299	513,22
47	Almora	66·0	7·20	35·95	6·78	49·84	5·38	58·6	9·07	465,893	+255,325	...	239,684	239,684	0·5	...	...	...
48	Garhwal	57·3	...	...	...	...	...	44·5	...	429,900	+22,082	...	262,464	262,484	0·6	...	...	...
	Total Hill Districts	61·6	3·60	17·97	3·39	24·92	2·69	51·6	4·53	895,793	+277,407	...	502,168	502,168	0·6	...	...	...
	Total U. P. of Agra and Oudh	40·4	3·07	24·59	2·06	40·82	3·28	38·0	2·97	47,691,782	+816,635	11,006,380	37,450,479	41,065,762	0·9	11,519,843	11,054,926	12,367,58

UNITED PROVINCES OF AGRA AND OUDH.

Statement II.—Showing gross areas irrigated from different sources in each district.

Serial No.	District.	1896-97.					1897-98.					1899-1900.				
		State works.	Private works.			Total.	State works.	Private works.			Total.	State works.	Private works.			Total.
		Canals.	Tanks.	Wells.	Other sources.		Canals.	Tanks.	Wells.	Other sources.		Canals.	Tanks.	Wells.	Other sources.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
1	Dehra Dun	19,598	...	31	14,438	34,067	22,715	...	28	14,715	37,458	21,414	...	17	16,693	38,124
2	Bijnor	25,362	2,700	26,969	1,773	56,813	17,214	2,435	22,900	4,960	48,538	22,372	2,430	35,106	4,953	64,861
3	Naini Tal	121,972	34	87	934	123,027	124,233	20	38	189	124,480	143,561	131	356	37	144,085
4	Bareilly	93,769	21,424	53,741	15,880	184,814	88,808	31,348	63,696	28,001	211,853	90,301	25,404	65,307	27,349	211,421
5	Pilibhit	21,236	9,009	42,365	9,544	82,154	20,494	21,828	40,806	14,069	97,197	22,033	9,059	43,337	9,544	83,973
6	Kheri	...	9,421	24,253	347	34,021	...	49,284	41,498	4,581	95,363	...	23,422	85,216	3,421	112,059
7	Bahraich	...	18,749	41,950	2,115	62,814	...	48,996	24,191	2,608	75,795	...	32,467	41,814	6,266	80,547
8	Gonda	...	33,164	156,366	5,053	194,583	...	59,875	159,771	4,840	224,486		66,334	161,021	5,423	232,778
9	Basti	...	132,016	288,008	84,733	504,757	...	212,875	202,304	123,263	538,442	...	246,968	215,090	125,499	585,157
10	Gorakhpur	...	100,615	383,451	62,237	546,303	...	251,982	255,700	98,464	606,146	...	307,960	312,358	124,063	744,381
	TOTAL TRACT 1	281,937	357,441	987,171	200,054	1,826,603	273,462	678,575	810,932	294,810	2,057,755	299,681	717,125	960,332	323,248	2,300,386
11	Moradabad	...	7,979	92,862	10,302	111,143	...	15,193	71,444	10,141	96,778	...	9,393	195,431	17,655	222,479
12	Budaon	...	14,449	88,657	7,418	110,524	...	41,142	123,264	28,025	192,431	...	22,843	202,774	30,077	255,794
13	Shahjehanpur	...	...	95,979	105,977	201,956	...		94,271	107,685	201,956	...	...	95,979	105,977	201,956
14	Hardoi	...	127,847	74,882	10,153	212,882	...	78,587	165,538	15,400	259,525	...	56,708	190,190	15,831	262,729
15	Sitapur	...	26,638	86,327	3,159	116,124	...	68,551	116,856	6,467	191,874	...	83,176	99,472	6,737	189,385
16	Lucknow	...	11,053	107,076	3,763	121,892	...	27,407	91,167	5,265	123,839	...	38,286	98,453	5,895	142,634
17	Bara banki	...	47,315	174,304	3,086	224,705	...	100,582	140,315	4,404	245,301	...	115,720	125,686	6,654	248,060
18	Fyzabad	...	55,244	287,913	5,552	348,709	...	145,245	183,555	7,452	336,252	...	148,973	193,522	7,718	350,213
19	Azamgarh	...	25,428	409,636	19,338	454,402	...	142,419	273,400	71,713	487,532	...	149,109	290,642	75,931	515,682
20	Ghazipur	...	8,723	186,250	4,636	199,609	...	56,464	159,076	5,699	221,239	...	61,363	177,538	8,221	247,122
21	Ballia	...	9,436	149,214	5,479	164,129	...	27,224	138,808	17,694	183,726	...	32,808	159,015	22,754	214,577
22	Unao	...	25,203	189,293	5,935	220,431	...	59,873	164,855	12,724	237,452	...	92,390	155,626	14,933	262,949
23	Rai Bareli	...	26,278	333,076	1,605	360,959	...	82,756	239,143	2,440	324,339	...	138,130	220,485	2,489	361,104
24	Sultanpur	...	80,988	205,284	3,429	289,701	...	115,481	160,399	3,917	279,797	...	125,526	163,365	3,616	292,507
25	Partabgarh	...	42,105	260,794	1,719	304,618	...	58,605	180,453	2,262	271,410	...	124,380	188,833	2,450	315,663
26	Jaunpur	...	7,711	356,504	214	364,429	...	75,985	300,949	780	380,714	...	61,567	331,634	1,275	394,476
27	Benares	...	9,613	120,043	1,273	130,929	...	32,380	119,365	2,928	154,673	...	23,062	137,424	1,907	162,393
	TOTAL TRACT 2	...	525,411	3,227,796	193,045	3,946,252	...	1,161,354	2,722,708	304,655	4,188,717	...	1,274,614	3,034,969	329,110	4,638,693
28	Saharanpur	154,637	6,929	55,572	4,841	221,979	148,593	2,415	48,037	2,096	197,441	173,080	2,713	77,381	8,885	262,059
29	Muzaffarnagar	244,128	3,996	108,341	2,414	358,877	223,947	2,031	82,017	1,697	310,392	269,451	1,742	130,279	3,363	404,835
30	Meerut	396,044	...	129,340	5,080	530,464	335,744		129,330	5,090	470,154	448,063	...	129,330	5,090	582,483
31	Bulandshahr	283,576	7,011	193,822	4,362	488,771	242,090	8,473	206,191	5,617	462,366	344,032	4,297	232,094	9,303	589,726
32	Aligarh	222,731	3,335	460,311	6,857	693,235	188,470	5,783	325,410	7,650	527,313	244,254	3,961	346,678	6,964	601,757
33	Muttra	145,431	108	189,227	1,032	335,798	101,814	28	134,599	486	236,927	117,813	112	172,719	526	291,170
34	Agra	71,453	525	286,059	1,560	359,597	45,127	346	156,064	430	201,967	56,477	362	250,586	1,118	308,543
35	Farrukhabad	115,358	7,076	218,432	12,532	353,398	89,111	14,835	163,312	11,920	279,979	76,853	18,549	162,014	10,263	269,638
36	Mainpuri	246,128	6,619	255,464	6,610	514,821	190,136	15,615	174,064	8,852	391,687	198,723	20,813	198,484	8,009	424,029
37	Etawah	293,080	2,971	85,719	2,173	383,943	240,836	6,774	61,580	2,150	311,340	212,894	7,702	63,603	2,514	286,713
38	Etah	173,628	5,313	252,862	5,701	437,504	147,475	14,464	175,523	6,633	344,095	168,630	12,487	190,082	8,601	379,800
39	Cawnpur	314,558	7,047	102,864	2,034	426,501	271,983	11,817	95,683	1,658	381,141	188,503	19,490	96,158	2,319	306,479
40	Fatehpur	...	10,657	133,753	534	144,944	114	50,065	133,045	1,095	184,319	15,904	60,873	123,792	1,475	208,044
	TOTAL TRACT 3	2,660,948	60,537	2,471,448	55,749	5,248,720	2,223,527	136,042	1,912,758	55,794	4,328,121	2,514,607	159,170	2,173,070	68,430	4,915,277
41	Jhansi	3,484	3,738	61,976	599	69,797	1,114	3,072	57,399	242	61,827	2,019	3,646	58,952	401	65,018
42	Jalaun	51,653	248	11,867	620	64,393	47,176	283	6,838	161	54,458	35,759	352	8,467	259	44,837
43	Hamirpur	3,950	598	18,077	194	22,819	3,385	812	16,298	116	20,611	2,621	1,340	17,316	113	21,390
44	Banda	...	268	5,313	780	6,361	...	591	3,796	390	4,777	...	1,248	4,650	408	6,306
45	Allahabad	...	36,516	219,669	815	257,000	...	93,963	163,407	958	258,347	4,506	87,031	181,062	824	273,423
46	Mirzapur	...	6,403	37,397	3,798	47,598	...	15,580	36,642	28,057	80,279	...	24,228	39,367	38,659	102,254
	TOTAL TRACT 4	59,092	45,071	354,299	6,806	489,268	51,675	114,323	284,357	29,944	480,199	44,915	117,835	309,804	40,674	513,228
47	Almora	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
48	Garhwal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	TOTAL HILL DISTRICTS	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	TOTAL U. P. OF AGRA AND OUDH	3,031,977	991,510	7,040,712	455,644	11,519,843	2,548,664	2,090,394	5,730,655	685,212	11,054,925	2,859,203	2,268,744	6,478,175	761,462	12,367,584

UPPER BURMA.

Statement showing present condition of districts with reference to Population, Cultivation, and Irrigation.

Serial No.	District.	Average annual rainfall in inches.	Population.		Area cultivable but not cultivated.	Cultivated area including current fallows.	Gross area.		Percentage of column 9 on column 8.	Area cropped per head of population.	Area irrigated per head of population.
			In 1901.	+ or — since 1891.			Cropped during 1900-1901.	Irrigated during 1900-1901.			
1	2	3	4	5	6	7	8	9	10	11	12
					Acres.	Acres.	Acres.	Acres.		Acres.	Acres.
1	Mandalay . .	40·0	366,507	- 7,553	32,419	210,037	125,567	37,222	37·5	0·3	·1
2	Bhamo . . .	67·7	79,515	13,145	834,114	18,186	18,186	3,500	19·2	0·2	...
3	Myitkyina . .	81·8	67,399	— 67,856	1,465,846	31,014	30,394	2,182	7·2	0·4	...
4	Katha . .	61·0	176,523	+ 61,112	500,000	190,429	169,226	25,935	15·3	0·9	·1
5	Ruby Mines . .	65·0	86,914	+ 60,780	349,606	10.380	7,158	2,270	31·7	0·1	...
	Total Mandalay Division . . .	63·1	776,858	+ 33,338	3,181,985	460,046	350,531	71,109	23·1	0·4	·1
6	Shwebo . . .	37·9	286,891	+ 194,342	653,421	465,656	413,104	83,535	27·5	1·4	·3
7	Sagaing . . .	29·0	282,708	+ 34,501	49,562	519,842	310,116	50,880	16·2	1·2	·2
8	Lower Chindwin .	30·7	276,383	+ 44,138	501,600	408,761	348,356	6,477	8	1·3	...
9	Upper „ .	70·6	154,551	+ 56,758	1,702,349	209,609	195,433	6,260	3·2	1·3	...
	Total Sagaing Division . .	42·0	1,000 533	+ 329,739	2,906,992	1,598,868	1,267,009	147,152	13·9	1·3	·1
10	Thayetmyo . .	39·1	239,706	— 111,705	142,789	65,261	65,261	500	0·8	0·3	...
11	Pokakku . .	35·2	356,189	+ 52,436	491,527	426,373	414.548	15,107	3·3	1·2	...
12	Minbu . . .	27·6	233,139	+ 8,664	250,000	404,189	271,528	58,628	22·0	1·2	·2
13	Magwe . .	29·6	246,708	+ 27,518	68,358	480,973	590,266	192,542	32·5	2·4	·8
	Total Minbu Division . . .	32·9	1,075,742	— 23,087	952,674	1 376,796	1,341,603	266,777	19·9	1·2	·2
14	Kyaukse . .	29·1	141,253	+ 14,631	103,296	227,704	164,409	124,366	79·5	1·2	·9
15	Meiktila . .	32·4	252,305	+ 45,655	222,283	600,611	440,643	143,035	52·5	1·7	·6
16	Yamothin .	37·6	243,197	+ 82,535	467,335	291,230	271,440	58,987	34·1	1·1	·2
17	Myingyan . .	24·8	356,145	+ 299,796	389,838	1,069,352	830,433	16,754	2·0	2·3	...
	Total Meiktila Division . . .	31·0	992,900	+ 442,617	1,182,752	2,188,897	1,706,925	313,142	27·6	1·7	·3
	Total Upper Burma .	43·5	3,846,033	+ 782,607	8,224,403	5,624,607	4,666,068	828,180	21·3	1·2	·2

Statement showing areas irrigated by Major and Minor

Year.	PUNJAB (BRITISH).			PUNJAB (NATIVE STATES).		
	Major works.	Minor works.	Total.	Major works.	Minor works.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
1881-82 . . .	668,547	976,774	1,645,321	...	...	...
1882-83 . . .	727,858	955,414	1,683,272	...	...	...
1883-84 . . .	868,316	783,752	1,652,068	...	...	...
1884-85 . . .	692,717	921,571	1,614,288	...	...	...
1885 86 . . .	942,854	843,991	1,786,845	...	...	...
1886-87 . .	1,054,856	893,877	1,948,733	63,807	...	63,807
1887-88 . . .	1,326,234	918,328	2,244,562	96,541	...	96,541
1888-89 . . .	1,609,723	997,428	2,607,151	140,234	...	140.234
1889-90 . . .	1,711,021	994,710	2,705,731	152,435	...	152,435
1890-91 . . .	1,816,917	982,956	2,799,873	216,583	...	216,583
1891-92 . . .	1,916,265	1,049,154	2,965,419	228,127	...	228,127
1892-93 . . .	1,707,320	1,079,709	2,787,029	140,562	...	140,562
1893-94 . . .	1,750,591	958,664	2,709,255	153,068	...	153,063
1894-95 . . .	1,706,471	1,063,296	2,769,767	149.887	...	149,387
1895-96 . . .	2,519,344	939,200	3,458,544	338,813	...	338,818
1896-97 . . .	3,204,810	960,110	4,164,920	456,707	...	456,707
1897-98 . .	3,652,478	1,153,334	4,805,812	403,420	5,026	408,446
1898-99 . .	3,159,759	970,259	4,430,018	412,742	14,005	426,747
1899-1900 . . .	3,893,635	849,694	4,743,329	491,337	10,287	501,624
1900-01 . .	4,356,992	1,345,804	5,702,296	285,860	12,395	298,255

Year.	BOMBAY (EXCLUDING SIND).			SIND.		
	Major works.	Minor works.	Total.	•Major works.	Minor works.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
1881-82 . . .	19,680	140,978	160,658	303,332	1,298,654	1,601,986
1882-83 . . .	17,857	149,147	167,004	309,450	1,363,813	1,673,293
1883-84 . . .	18,745	152,685	171,430	323,795	1,217,036	1.540,831
1884 85 . . .	21,609	158,681	180,290	392,386	1,390,787	1,783,173
1885-86 . . .	42,322	141,429	183,751	402,004	1,337,915	1,739,919
1886-87 . . .	28,812	155,672	184,484	409,171	1,405,479	1,814,650
1887-88 . . .	31,172	158,941	190.113	416,339	1,424,775	1.871,114
1888-89 . .	53,057	169,821	222,878	575,745	1,542,890	2,118,635
1889-90 . . .	56,381	175,421	231,802	630,111	1,719,708	2,349,819
1890-91 . . .	50,584	170,880	221,464	517,954	1,685,519	2,203,473
1891-92 . . .	68,537	174,134	242,671	466,083	1,699,548	2,165,631
1892-93 . . .	45,202	167,471	212,673	554,369	1,844,686	2,399,055
1893-94 . . .	55,747	172,646	228,393	558,488	1,827,789	2,386,277
1894-95 . . .	60,707	168,594	229,301	607,035	2,028,691	2,635,726
1895-96 . . .	49,989	169,945	219,934	531,726	1,565,051	2,096,777
1896-97 . .	79,926	184,110	264,036	630,037	1,867,319	2,497,356
1897-98 . . .	86,778	187,711	274,489	753,822	2,052,261	2,806,083
1898-99 . . .	67,850	183,569	251,419	688,650	1,767,401	2,456,051
1899-1900 . . .	67,227	170,511	237,738	808,141	1,760,362	2,568,503
1900-01 . . .	84,472	167,333	251,805	961,484	2,082,425	3,043,859

Works in each Province in each year since 1881-82.

UNITED PROVINCES			BENGAL.		
Major works.	Minor works.	Total.	Major works.	Minor works.	Total.
Acres.	Acres.	Acres.	Acres	Acres.	Acres.
1,811,096	104,853	1,915,949	414,787	666	415,453
1,872,460	101,715	1,974,175	408,791	1,741	410,532
2,188,468	109,206	2,297,674	497,293	21,122	518,415
1,513,180	104,125	1,617,305	498,897	7.223	506,120
1,608,371	101,305	1,709,676	475,513	4,565	480,078
1,267,576	96,239	1,368,815	415,575	2,146	417,721
1,397,781	119,507	1,517,288	490,750	4,218	494,968
1,489,351	115,402	1,604,753	584,978	15,773	600,751
1,753,821	125,582	1,879,403	560,719	23,042	583,761
1,887,777	126,337	2,014,114	543,315	4,410	547,725
1,912,851	132,179	2,045,030	736,381	23,736	760.117
1,663.393	136,453	1,799,846	662,930	81,293	744,223
1,568,298	76,899	1,645,197	556,065	16,378	572,443
855,247	74,214	929,461	509,811	25,908	535,719
1,868,447	141,574	2,010,021	579,933	38,475	618,408
2,845,906	177,978	3,023,884	805,387	36,625	842,012
2,345,696	165,477	2,511,173	701,253	28,039	729,292
2,152,353	101,449	2,253,802	712,221	32,947	745,168
2,653,494	176,300	2,829,794	727,026	29,708	756,731
1,888,091	112,835	2,000,926	716,271	33,119	719,390

MADRAS.			RAJPUTANA AND CENTRAL INDIA AGENCY.		
Major works.	Minor works.	Total	Major works.	Minor works.	Total.
Acres	Acres.	Acres.	Acres	Acres.	Acres.
1,801,131	3,350,183	5,151,314	...	21,192	21,192
1,912,222	3,343.382	5.255,604	...	27,462	27,462
1,969,817	3.526,778	5,496,595	...	22,560	22,560
1,793,695	3,380,029	5,173,724	...	21,780	21.780
2,098,223	3,488,084	5,586,307	...	23,408	23,408
2,115,936	3,607,707	5,723,643	...	20,475	20,475
2,184,012	3,658,228	5,842,240	...	24,665	24,665
2,266,530	3,640,285	5,909,815	...	27,631	27,631
2,311,409	3,649,361	5,960,770	...	23,191	23,191
2,346,732	3,486,675	5,833,407	...	28,517	28,517
2,413,508	3,099,870	5,513,378	...	11,987	11.987
2,396,521	3,671,558	6,068,079	...	36,330	36,330
2,389,798	3,844,391	6,234.189	...	31,244	34,244
2,456,748	3,517,624	5,974,372	...	33,920	33,920
2,406,090	3,926,392	6,332,482	...	31,129	31,129
2,606,435	3,475,810	6,082,215	...	36.703	36,703
2,705,915	3,666,822	6,372,737	...	38,321	38,321
2,775,782	3,914,057	6,689,839	...	25,592	25,592
2,768,668	3,345,657	6,114,325	...	13,421	13,421
2,915,271	3,684,853	6,600,124	...	34,791	34,791

Statement showing areas irrigated by Major and Minor Works in each Province in each year since 1881-82—concld.

Year.	BALUCHISTAN.			UPPER BURMA.		
	Major works.	Minor works.	Total.	Major works.	Minor works	Total.
	Acres	Acres.	Acres.	Acres.	Acres.	Acres.
1881-82 . . .	...	...	...	...	...	...
1882-83 . . .	...	...	...	...	..	...
1883-84 . . .	...	...	...	...	...	...
1884-85 . . .	...	...	...	...	...	...
1885-86 . . .	...	...	...	...	...	...
1886-87 . . .	...	...	...	...	...	...
1887-88 . . .	...	...	...	...	...	...
1888-89 . . .	...	1,194	1,194	...	...	...
1889-90 . . .	...	1,666	1,666	...	...	...
1890-91 . . .	...	2,656	2,656	...	...	...
1891-92 . . .	...	5,901	5,901	...	196,311	196,311
1892-93 . . .	...	10,485	10,485	...	203,358	203,358
1893-94 . . .	...	6,251	6,251	...	258,892	258,892
1894-95 . . .	...	4,896	4,896	...	254,233	254,233
1895-96 . . .	...	5 855	5,855	...	278,860	278,860
1896-97 . . .	...	3,355	3,355	..	268,476	268,476
1897-98 . . .	...	6,090	6,090	...	319,541	319,541
1898-99 . . .	...	5,653	5,653	...	338,715	338,715
1899-1900 . . .	...	3,091	3,091	...	362,556	362,556
1900-01 . . .	...	5,232	5,232	..	419,747	419,747

Year.	TOTAL OF ALL PROVINCES.		
	Major works.	Minor works.	Total.
	Acres.	Acres.	Acres.
1881-82	5,018,573	5,893,300	10,911,873
1882-83	5,248,638	5,942,704	11,191,342
1883-84	5,866,434	5,833,139	11,699,573
1884-85	4,912,484	5,984,196	10,896,680
1885-86	5,569,287	5,910,697	11,509,984
1886-87	5,355,733	6,181,595	11,537,328
1887-88	5,972,829	6,308,662	12,281,491
1888-89	6,719,618	6,513,424	13,233,042
1889-90	7,175,897	6,712,681	13,888,578
1890-91	7,379,862	6,487,950	13,867,812
1891-92	7,741,752	6,392,820	14,134,572
1892-93	7,170,297	7,231,343	14,401,640
1893-94	7,032,050	7,196,154	14,228,204
1894-95	6,345,406	7,171,376	13,516,782
1895-96	8,294,342	7,096,481	15,390,823
1896-97	10,629,208	7,010,486	17,639,694
1897-98	10,649,362	7,622,622	18,271,984
1898-99	10,269,357	7,353,647	17,623,004
1899-1900	11,409,528	6,721,587	18,131,115
1900-01	11,208,391	7,898,034	19,106,425

LIST OF STATE IRRIGATION WORKS IN BRITISH INDIA WHICH WERE OPENED FOR IRRIGATION BEFORE 1st APRIL 1901. I. Works with Capital Account. (1) Canals.

Serial No.	Name of Work.	Year in which opened for irrigation.	Name of river from which supply is drawn.	Rabi supply in river.		Maximum discharging capacity of canal.	Total cultivable area commanded.	Areas irrigated annually during past ten years.		Average area annually irrigated during the five years ending 1900-01.			Total mileage of channels at end of 1900-01.	Average financial results for five years ending 1900-01.				Surplus of net revenue over interest charges to end of 1900-01.	Proposed extension.	
				Average.	Minimum recorded during rabi season.			Maximum.	Minimum.	Kharif.	Rabi.	Total.		Capital cost of work.	Gross revenue realized during year.	Annual net revenue.	Return on capital cost.		Additional cultivable area to be commanded.	Probable cost.
1	2		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
				Cusecs.	Cusecs.	Cusecs.		Acs.	Acs.	Acs.	Acs.	Acs.		Rs.	Rs.	Rs.	Rs.	Rs.	Acs.	Rs.
										Punjab.										
1	Swat River Canal	1886	Swat	2,500	1,172	775	155,153	166,031	81,210	52,104	93,004	145,108	208	3,950,670	4,34,684	3,45,313	8·7	1,42,919	11,000	80,000
2	Western Jumna	1820	Jumna	4,423	1,350	6,350	2,144,847	764,206	262,787	356,760	329,877	686,637	2,601	1,62,10,096	26,88,325	17,82,624	11·0	3,65,20,379	..	..
3	Bari Doab	1861	Ravi	2,688	1,200	6,500	1,479,257	861,301	534,697	382,409	412,760	795,169	1,710	1,80,99,628	31,34,911	23,44,925	13·0	1,42,28,870	4,20,000	10,00,000
4	Sirhind	1884	Sutlej	4,685	2,813	5,120	2,456,410	943,789	275,587	329,808	517,864	847,672	3,044	2,42,49,911	29,93,365	22,26,417	9·2	−18,60,261	...	...
5	Chenab	1892	Chenab	8 238	3,367	10,730	2,905,635	1,830,525	35,524	424,901	669,445	1,094,347	2,489	2,17,53,433	30,68,172	21,95,056	10·5	43,05,843	11,00,000	34,00,000
6	Lower Sohag and Para	1884	Sutlej	4,900	2,700	6,200	207,983	102,014	52,745		...	74,901	101	7,23,591	1,35,273	49,790	6·9	74,729	29,400	73,395
7	Sidhnai Series. Sidhnai	1886	Ravi	955	...	2,385	344,000	159,214	21,157	60,621	43,832	104,453	163	11,78,891	2,61,421	1,19,007	10·1	14,09,428	...	...
8	Karanga	1890			...	235		5,701	796	1,730	1,990	3,720	15							
9	Fazil Shah	1890			...	200		12,399	2,730	4,752	4,478	9,230	11							
10	Abdul Hakim	1891			.	150		8,717	1,534	3,109	2,590	5,699	10							
11	Shahpur (Imperial)	1871	Jhelum	9,000	4,988	1,100	62,954	50,381	11,766	16,505	19,897	36,402	173	2,07,416	97,815	46,166	...	...	..	...
12	Ghaggar Inundation Canals	1897	Ghaggar	...	.	600	40,000	51,504*	19,136*	17,978*	10,669*	28,647*	68	2,41,243	.	−24,315	−10·0	...	...	...
										Sind.										
13	Eastern Nara System. Nara supply channel	1860	Indus	...	...	20,000	6,070	18,110	1,284	985	4,454	5,439	12	59,06,249	5,90,811	4,49,793	7·6	...	50,407	2,78,266
14	Eastern Nara direct	1855		...	...	20,000	275,500	77,000	29,842	31,770	26,004	57,774	320							
15	Mithras Canal	1880		.	...	2,900	599,800	196,124	89,433	115,397	34,859	150,256	155							
16	Thar "	1865		...	...	1,400	114,800	81,339	30,400	52,424	8,492	60,916	72							
17	Dim "	1853		...	...	372	52,000	8,399	4,621	5,326	740	6,066	28							
18	Heran "	1882		...	...	80	9,000	3,418	1,503	2,139	304	2,443	3							
19	Khipra "	1873		...	..	193	45,000	8,426	4 237	3,366	2,174	5,540	15							
20	Jamrao Canal	1900		...	..	3,200	822,000	...	...	123,000	61,000	184,000†	528	75,90,760	3,42,873	2,66,427	3·5	...	...	...
21	Mehrabwah	1883		...	...	451	78,000	15,752	11,251	12,474	978	13,452	41	66,018	578	−4,834	−7·3	...	...	..
22	Alibahar Kacheri	...		...	...	527	53,300	12,661	9,123	10,452	366	10,818	59	23,207	3,326	5,622	24·2	...	...	...
23	Great Marak	1871		...	...	1,831	277,900	69 548	52,320	59,163	3,234	62,397	168	2,10,518	67,872	41,907	20·9	...	...	...
24	Sarfraz	...		. .	...	1,069	242,000	34 389	25,340	28,247	2,139	30,386	102	1,18,559	26,073	17,773	15·0	...	...	..
25	Fuleli Canal	1856		...	. .	9,500	1,577,000	415,834	324,935	324 789	58 989	383,788	1,048	14,90,074	4,72,968	3,60,798	24·8	...	58,000	3,00,000
26	Desert Canal	1854		.	...	4,469	287,492	101,574	31,797	74 597	8,448	83,095	218	58,839	1,64,387	95,589	162·0	...	...	...
27	Unharwah	1846		..	. .	2,594	214,056	65,578	23,277	65,150	14,426	79,576	96	23,640	1,53,130	1,09,061	461·0	...	...	..
28	Begari Canal	1853		...	. .	6,498	500,521	235,934	152,330	158,293	50,048	208,341	158	18,771	4,31,739	3,28,934	1,757·0	...	268,000	Not known.
29	Sukkur Canal	1871		.	...	3,081	153,995	128,949	72,025	61,568	22,485	84,053	130	17,512	1,28,694	75,281	430·0	...	...	
30	Ghar Canal Works	1854		...	...	5,550	387,038	274,689	144,752	201,998	33,020	235,018	297	4,368	5,31,856	3,55,853	8,146·0	...	166,400	Ditto.
										Madras Presidency.										
31	Godavari Delta System	1847	Godavari	Information not available.	Information not available.	8,516	772,699	825,519	688,126	653,171	125,011	778,182	503	1,30,21,834	30,30,636	22,78,642	17·5	4,05,84,600	...	...
32	Kistna " "	1856	Kistna			8,126	854,276	600,002	471,401	551,329	398	551,727	372	1,29,68,565	25,91,084	18,65,367	14·3	2,34,29,593	...	...
33	Cauvery " "	1837	Cauvery			43,750	919,539	1,012,049	954,123	881,601	100,151	981,752	844	22,85,631	9,42,496	8,47,155	37·7	2,49,73,437	...	.
34	Lower Coleroon	1849	Coleroon			3,062	136,533	113,741	107,473	106,597	4,565	111,162	350	9,39,017	2,77,627	2,34,999	25·2	...	...	..
35	Kurnool-Cuddapah Canal	1884	Penner and Tunga-bhadra.			1,468	300,000	87,236	30,766	55,506	9,009	64,515	190	2,17,16,772	1,65,244	60 805	0·3	1,65,55,930	6,000	3,06,000

* During five years ending 1901-02. | † For 1900-01.

LIST OF STATE IRRIGATION WORKS IN BRITISH INDIA WHICH WERE OPENED FOR IRRIGATION BEFORE 1ST APRIL 1901—*contd.* I. Works with Capital Account. (1) Canals.

Serial No.	Name of Work.	Year in which opened for irrigation.	Name of river from which supply is drawn.	RABI SUPPLY IN RIVER.		Maximum discharging capacity of canal.	Total cultivable area commanded.	AREAS IRRIGATED ANNUALLY DURING PAST TEN YEARS.		AVERAGE AREA ANNUALLY IRRIGATED DURING THE FIVE YEARS ENDING 1900-01.			Total mileage of channels at end of 1900-01.	AVERAGE FINANCIAL RESULTS FOR FIVE YEARS ENDING 1900-01.				Surplus of net revenue over interest charges to end of 1900-01.	PROPOSED EXTENSION.	
				Average.	Minimum recorded during rabi season.			Maximum.	Minimum.	Kharif.	Rabi.	Total.		Capital cost of work.	Gross revenue realized during year.	Annual net revenue.	Return on capital cost.		Additional cultivable area to be commanded.	Probable cost.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
				Cusecs.	Cusecs.	Cusecs.		Acs.	Acs.	Acs.	Acs.	Acs.		Rs.	Rs.	Rs.	Rs.	Rs.	Acs.	Rs.
	Madras Presidency—*concld.*																			
36	Muniyeru Project	1899	Muniyeru	Information not available.	Information not available.	227	13,024	2,923	911	2,015	49	2,064	50	3,58,489	6,908	2,177	0·6	...	...	...
37	Shatiatope	1849	Vallur			...	39,085	33,951	29,646	28,787	4,664	33,451	41	1,83,820	1,04,110	85,225	46·4	...	10,000	2,75,000
38	Vallur Anicut	1872	Kortalyar			114	6,794	5,418	4,087	5,012	200	5,212	3	64,662	3,694	3,132	4·8	...	...	...
39	Thadapalli Channel	1856	Bhabani			725	13,718	19,880	14,457	14,338	586	14,924	76	1,23,444	30,738	20,540	16·6	...	...	...
40	Arkenkota	1855	Ditto			552	4,118	4,424	4,116	4,170	44	4,214	24	1,02,984	9,169	4,255	8·9	...	...	...
41	Kalingaroyen	1856	Ditto			893	9,026	21,861	21,373	11,358	10,195	21,553	61	76,748	20,965	10,442	13·6	.	...	...
42	Nandiyar Channel	1896	Nandiyar			143	9,480	7,228	5,434	4,688	1,996	6,684	24	54,104	1,786	—2,586	—4·8	...	...	. .
43	Ganjam	1853	Langulia Vansudhara Garibulyoor			...	61,500	73,284	55,715	56,354	9,002	65,356	100	1,67,690	56,488	5,098	3·0	...	...	...
	Bengal.																			
44	Orissa Canals	1866	Mahanadi, Brahmini and Byturni	6,612	234	6,058	576,264	203,540	103,526	189,134	6,839	195,973	280	1,88,11,861	4,67,913	—23 916	—0·12	2,93,59,421	...	...
45	Midnapur „	1866	Cossye	17	9	1,500	173,160	91,217	65,183	71,791	1,489	73,280	72	53,69,207	2,50,530	10,231	0·19	90,32,123	. .	...
46	Sone „	1876	Sone	1,743	828	6,350	1,354,302	555,156	317,134	334,565	128,616	463,181	367	1,87,96,274	11,17,218	5,08,857	2·70	2,10,51,459	...	...
47	Saran „	1881	Gandak	780	Not recorded.	1,084	50,000	5,955	1,552	1,137	889	2,026	19	4,84,849	2,596	—3,889	—0·80	...	...	...
	United Provinces.																			
48	Ganges Canal	1855	Ganges	4,500 to 10,000	4,427	6,750	2,337,710	1,261,601	351,637	405,261	581,652	986,913	4,936	2,99,87,890	42,57,445	31,17,957	10·6	1,27,58,890	163,854	4,14,556
49	Lower Ganges, including Fatehpur Branch.	1878	Ditto	2,900	1,300	4,100	4,390,233	1,042,062	231,143	259,070	546,184	805,254	4,497	3,72,40,481	26,26,612	16,02,554	4·3	—30,82,629	18,958	98,708
50	Fatehpur Branch	1898	Lower Ganges Canal.	...	...	600	607,000	63,584	19,787	...	...	...	459	19,16,436	...	...	...	...	...	...
51	Agra Canal	1874	Jumna and Hindan.	1,131	406	2,000	549,522	308,004	107,054	100,003	137,583	237,586	889	95,40,173	8,42,878	5,88,134	6·2	—14,09,353	20,000	1,88,889
52	Eastern Jumna Canal	1830	Jumna	1,278	316	1,300	621,825	324,700	125,260	147,034	151,655	298,689	1,250	38,64,233	14,99,437	11,02,603	29·5	2,20,92,711	14,377	1,30,500
53	Dun Canals :—																			
54	Bijapur	1840	Tons	338	25	89	20,000	6,436	3,081	2,503	3,110	5,613	12	7,14,127	25,906	57,617	8·1	...	13,916	...
55	Rajpur	1844	Rispana	78	6	34		2,730	1,441	825	1,305	2,130	14		21,520					
56	Kata Pathar	1854	Jumna	339	40	86		7,517	2,533	2,835	3,578	6,413	26		17,952					
57	Kalanga	1858	Sone and Baldi.	296	20	80		4,105	1,988	1,562	2,111	3,673	14		12,446					
58	Jakhan	1858	Jakhan	81	1	20		1,927	429	465	1,121	1,586	13		5,435					
	Rohilkhand Canals :—																			
59	Kailas	1863	Kailas	54	17	70	626,600	14,902	4,008	5,502	5,336	10,838	73	18,40,566	1,76,420	58,509	3·2	...	11,000	69,000
60	Bahgul	1850	Bahgul	41	17	100		45,596	17,326	22,064	12,578	34,642	152							
61	Kicha	1849	Kicha	51	44	180		17,468	4,141	4,655	6,785	11,440	70							
62	Paha	1849	Paha	35	14	80		18,821	7,725	6,711	4,719	11,430	52							
63	River water-courses and other small works.	...	...	...	...	...		47,578	20,046	19,651	17,425	37,076	26							
	Bijnor Canals :—																			
64	Nagina	1840	Koh	44	21	70	72,320	12,226	917	4,765	4,900	9,665	42	1,67,450	43,629	23,189	18·8	.	...	...
65	Nehtor	1850	Gangan	23	13	90		13,184	1,570	3,413	2,918	6,331	31							
66	Rivers	...	...	...	...	...		4,121	2,397	1,835	894	2,729	8							

LIST OF STATE IRRIGATION WORKS IN BRITISH INDIA WHICH WERE OPENED FOR IRRIGATION BEFORE 1st APRIL 1901. I. Works with Capital Account.

(2) Storage Works.

Serial No.	Name of Work.	Year in which opened for irrigation.	Source or sources of supply.	Rabi supply in river.		Total area of catchment of reservoir.	Average rainfall over catchment.	Contents of reservoir from sill of canal head sluices to F. S. L.	Total area of surface of reservoir at F. S. L.	Maximum discharging capacity of canal at head.	Total culturable area commanded.	Maximum area irrigated in any one year of the *decade* ending 1900-01.	Minimum area irrigated in any one year of the *decade* ending 1900-01.	Average area annually irrigated during the five years ending 1900-01.			Dam.		Total mileage of canals and channels open at end of 1900-01.	Mean of capital outlay to end of 1895-96 and 1900-01.	Average annual *gross* revenue realized during the five years ending 1900-01.	Average annual *net* revenue realized during the five years ending 1900-01.	Percentage of column 23 on 21.	Proposed extensions.	
				Average (ten years).	Minimum recorded during rabi season (of ten years).									Kharif.	Rabi.	Total.	Earthen (E) or Masonry (M).	Total height above lowest point of ground or river bed.						Additional culturable area to be commanded.	Probable cost.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
				Cusecs.	Cusecs.	Square miles.	Inches.	Millions of cusecs.	Acs.	Cusecs.	Acs.	Acs.	Acs.	Acs.	Acs.	Acs.		Feet	Miles.	Rs.	Rs.	Rs.		Acs.	Rs.
	Bombay Presidency.																								
67	Nira Canal, Lake Whiting.	1885	River Nira and Bhotghar reservoir.	250	183	128	145·00	5,500	3,584	456	227,670	51,728	18,246	15,509	25,174	40,683	M	127 108	239	56,63,245	1,27,713	67,132	1·20	2,47,000	1,08,85,000
68	Mahswad tank	1885	Man river and rainfall.	70	53·03	480	22·78	2,633	4,018·80	178·81	106,214	13,656	3,461	3,002	4,854	7,866	E	79·79	99	20,75,989	19,432	2,376	0·11	...	...
69	Hathmati canal	1873	Hathmati river	45	·88	...			...	191·00	28,940	5,390	110	1,247	1,856	3,093	..	..	51	5,17,838	8,491	1,709	0·33	...	...
70	Lower Panjra, R. Works.	1874	Local streams	4	...	34	22·01	312·3	509	41·00	12,627	3,968	2,455	1,386	1,748	3,134	E	65	45	4,66,542	16,952	9,153	1·96	...	...
71	Kadwa river works. Waghad tank	1886	Kolvan river	...	..	29	51·11	606	778	...							E	95		7,41,739	9,606	−10,313	−1·39	...	...
72	Palkhed canals	1873	Kadwa "	21	17·06	...	...	...	..	63·00	16,280	2,323	1,622	723	1,263	1,986	...	...	25						
73	Ozar Tambat canals.	1873	Bangaya "	4	2·07	...	..	...	...	33·00	7,421	628	251	234	300	534	...	...	5						
74	Wadoli	1868	Kadwa "	6	3·44	...	...	...	...	10·00	2,729	515	347	148	273	421	...	..	9						
75	Pravara River Works (Lakh canal.)	1868	Pravara "	29	9·60	...		...	...	127·00	25,536	1,674	158	412	715	1,127	...	...	32	3,71,801	1,984	−19,199	−5·16	1,26,400	26,68,000
76	Mutha canals (Lake Fife.)	1873	Mutha river and rainfall	137	82·64	196	32·39	(1) 2,679·65 (2) 3,283·30	3,299·24 3,629·78	412·00 38·50	49,800	14,061	6,457	7,492	1,332	8,824	M	97·84	135	66,28,753	2,51,089	1,67,685	2·53	...	14,96,000
77	Ekruk tank	1871	Adhela " "	35	8·06	159	30·78	3,310	4,551	51·60	16,941	4,994	1,947	2,087	1,573	3,660	E	76	43	13,40,383	24,677	7,932	0·59	...	...
78	Krishna canal	1868	Krishna " "	84	35·50	...	..	..	...	140·00	26,453	8,288	3,264	3,630	2,301	5,931	...	...	64	8,64,882	44,[illegible]	28,636	3·31	..	...
79	Khari cut	1881	Khari "	2	...			...	...	150·00	[illegible]	3,126	.	2,046	13	2,059	..	...	36	3,05,914	10,459	4,007	1·31	20,000	5,34,000
80	Hartala tank	1874	Local streams	...		7	24·88	134·9	472	6·00	527	231	4	36	37	73	E	51·50	6	73,382	640	367	0·50	..	...
81	Mhaswa "	1877	Ditto	2	0·68	13	18·64	158·5	421	13·65	4,175	899	54	111	361	472	E	44	7	1,38,956	1,255	70	0·05	.	..
82	Jamda canal	1866	Girna river	50	11·89	..	.	..	.	191·00	40,185	4,980	873	1,285	2,492	3,777		.	114	10,41,[illegible]	9,222	−13,657	−1·31	42,383	13,23,162
83	Parsal tank	1889	Parsul "	3	1·20	17	20·32	118·70	151	40·00	3,197	822	172	162	391	553	E	62·27	5	2,15,694	1,679	378	0·17	..	...
84	Pravara R. Works, Ozar canal.	1874	Pravara "	40	12·64	...	.	...	...	113·00	21,155	7,380	1,100	2,489	3,013	5,502	...	...	40	3,34,502	8,300	9,008	2·69	1,20,000	46,80,000
85	Bhatodi canal	1871	Mehekri "	8	4·47	44	24·56	154	315·13	59·00	12,057	1,698	743	467	620	1,087	M	59	11	3,79,707	4,784	−4,008	−1·06	....	...
86	Matoba tank	1878	Nala, rainfall and surplus water from Mutha right bank canal.	9	3·66	10	17·09	229	477·48	26·00	7,123	2,853	885	1,172	903	2,075	E	48·41	17	2,01,423	9,482	6,137	3·04	...	...
87	Kasurdi "	1869	Kasurdi nala and rainfall.	...	...	6	19·09	14·5	37·92		478	189	...	15	54	69	E	33·45	2	45,590	545	−525	−1·15	..	...
88	Shirsuphal "	1878	Minor tributary of the Bhima river and rainfall.	4	...	23	18·71	365	633·79	30·00	2,500	1,523	177	442	621	1,063	E	54·32	12	2,24,568	2,706	−271	−0·12	...	...
89	Bhadalwadi "	1881	Ditto	5	3·70	23	21·19	222	335·18	26	2,400	1,835	299	424	1,030	1,454	E	55·09	10	2,27,422	3,146	492	0·21	...	...
90	Koregaon "	1866	Nala and rainfall	2	0·25	4·4	30·41	81	202	4·21	Not known.	429	13	21	198	219	2 Dams 1 E 1 M	71 16	4	39,180	557	−175	−0·45	...	..
91	Ashti "	1881	Ashti nala and rainfall	12	6·71	92	26·70	1,419	2,930	20·00	16,825	6,073	839	585	1,929	2,514	E	57·75	29	5,33,600	5,431	−7,474	[illegible]	...	...
92	Bevari canal	1865	River Warna and rainfall.	8	1·06	...	...	..	...	15·00	3,624	1,577	162	138	1,056	1,194	..	...	10	59,811	6,196	3,960	6·64	...	...
93	Upper Man R. Works (Pingli tank.)	1878	Man river and rainfall	7	1·71	20·00	18·67	195·24	394·04	62	7,623	2,022	888	689	948	1,637	E	53·50	24	4,34,329	3,720	−4,690	−1·08	...	...
94	Yerla R. Irrigation (Naher tank.)	1868	Yerla " "	19	9·54	59·5	26·30	489·77	676·09	122·52	10,869	4,123	1,531	649	2,980	3,629	E	74	33	7,18,944	9,093	−3,695	−·51	...	14,23,000
95	Chikhli canal	1870	River Nandni and rainfall.	6	0·24	...	...	...	...	15·00	1,478	626	45	339	101	440	.		7	57,442	1,024	205	0·35	...	...
96	Maini tank	1876	Wanga nala and rainfall.	8	4·66	54·00	21·06	188·59	380·04	33·00	4,625	1,998	1,101	854	701	1,555	E	57·33	17	4,17,455	4,065	683	0·16	...	...
97	Muchkundi "	1886	Muchkundi Nala and rainfall.	Not gauged.	...	26·00	21·55	624	1,059	..	5,417	205	3	10	22	32	M	60	8	1,78,707	264	−102	−·06	..	...
98	Nilgund "	...	......	...	...	...	...	...	...	...	...	..	...	...	...	...	..	..	...	...	.	...	...	...	...

(1) Right Bank. | (2) Left Bank.

LIST OF STATE IRRIGATION WORKS IN BRITISH INDIA WHICH WERE OPENED FOR IRRIGATION BEFORE 1st APRIL 1901—*contd.* I. Works with Capital Account.

(2) Storage Works.

Serial No.	Name of Work.	Year in which opened for irrigation.	Source or sources of supply.	Rabi supply in river. Average (ten years).	Rabi supply in river. Minimum recorded during rabi season (of ten years).	Total area of catchment of reservoir.	Average rainfall over catchment.	Contents of reservoir from sill of canal head sluices to F. S. L.	Total area of surface of reservoir at F. S. L.	Maximum discharging capacity of canal at head.	Total cultivable area commanded.	Maximum area irrigated in any one year of the *decade* ending 1900-01.	Minimum area irrigated in any one year of the *decade* ending 1900-01	Average area annually irrigated during the five years ending 1900-01. Kharif.	Average area annually irrigated during the five years ending 1900-01. Rabi.	Average area annually irrigated during the five years ending 1900-01. Total.	Dam. Earthen (E) or Masonry (M).	Dam. Total height above lowest point of ground or river bed.	Total mileage of canals and channels open at end of 1900-01.	Mean of capital outlay to end of 1898 99 and 1900 01.	Average annual *gross* revenue realized during the five years ending 1900-01.	Average annual *net* revenue realized during the five years ending 1900-01.	Percentage of column 23 on 21.	Proposed extensions. Additional cultivable area to be commanded.	Proposed extensions. Probable cost.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
				Cusecs.	Cusecs.	Square miles.	Inches.	Millions of cusecs.	Acs.	Cusecs.	Acs.	Acs.	Acs.	Acs.	Acs	Acs.		Feet.	Miles.	Rs	Rs.	Rs.		Acs.	Rs.
	Bombay Presidency—concld.																								
99	Gadikari tank	1882	Rainfall	...	..	4·68	28 75	27·5	129	41	487	337	337	337	...	337	E	30	...	9,279	1,987	1,118	12·04	...	...
100	Dambal ,,	1880	,,	3		43	19 53	113·76	442	20 00	2,500	584	171	311	56	367	E	42·25	3	83,960	1,594	1,066	1·66	...	...
101	Madhri ,,	1884	Madhri nala and rainfall.	1	0 19	11	21 59	67 60	169	9 31	630	145	72	73	29	102	E	41	6	81,392	627	—104	—·12	...	...
102	Madag ,,	1865	Kumudbati river and rainfall.	8	5·15	540	29 53	54·63	362	53·00	1,345	1,314	693	508	402	910	E	100	9	1,67,598	2,142	535	0·32	...	...
103	Assundi ,,	1881	Rainfall	2	0 63	23	23 15	74 90	418	13·50	1,011	396	158	97	237	334	E	33·95	5	74,995	1,220	1,785	2·38	...	...
104	Mavinkop ,,	1882	,,	...	...	6 25	39·01	45 75	170 5	...	755	540	441	540	...	540	E	30·53	...	32,079	2,061	1,851	5 77	...	...
105	Gokak canal, 1st section and storage works.	1884	River Ghatprabha and storage works.	23	16·69	1,080	Dupdhal 25 34 Gokak 23 02	918 93	2,731·86	65	17,627	10,508	3,848	4,744	2,818	7,562	M	27	44	12,73,143	30,533	23,276	1·90	2,82,000	Not known
	Madras Presidency.																								
106	Penner river canal system.	1861	Penner	Information not available.	Information not available.	...	...	...	...	7,106	190,000	157,736	74,861	139,957	8,753	148,710	M	9 and 9	31	58,29,943	3,46,029	2,84,242	4·88	...	...
107	Barur tank project	1858	The Ponniar and rainfall.			1,900	34 63	313	668	...	Unlimited.	5,561	2,757	2,856	2,035	4,891	M	28	7	4,25,149	1,743	1,014	0·24	..	...
108	Srivaikuntam anicut	1871	The Tambraparni			...	...	...	...	1,860	33,500	45,715	29,111	22,068	20,204	42,272	M	8	28	14,76,938	1,15,161	76,877	5·21	...	...
109	Periyar project	1897	The Piruyar and Vaijai rivers.			300	75 57	6,480	6,395	...	107,650	142,869	67,051	80,884	27,632	108,516	M	173	36	56,68,656	2,70,036	1,70,209	3·00	20,000	...
110	Rushikulya project	1893	The Mahanadi and Rushikulya.			1,740	45·00	4,050	7,900	...	142,000	82,965	4,183	73,551	2,040	75,591	M	60	8	45,28,115	80,941	28,367	0·63	...	...
111	Donapad tank	1899	Rainfall			56	19 88	227	704	...	2,880	125	109	117	...	117	E and M	22	...	1,31,715	427	—131	—0·17	...	...
112	Sagileru project	1899	The Sajileru			...	..	...	...	450	26,576	6,965	4,278	2,486	705	3,191	M	...	14	3,66,102	1,567	—1,307	—0·43	...	...
113	Cumbum tank project	1877	The Gundlacamma and Jampuleru.			430	15 40	6,045	6,000	...	6,000	10,626	5,943	5,458	2,852	8,310	E	80	...	64,263	4,221	3,332	5·18	...	...
114	Palar anicut system	1854	The Palar			...	...	...	...	5,546	60,959	107,122	86,610	70,419	21,586	92,005	M	8·20	163	20,73,162	1,12,537	55,697	2·68	...	...
115	Poiney	1856	The Poiney			...	...	...	...	1,231	2,650	30,227	18,586	19,229	4,424	23,653	M	6·80	104	2,34,034	40,106	26,967	11·53	...	...
116	Cheyaru	1853	The Cheyar			...	...	...	...	1,463	18,172	37,441	23,558	20,074	13,341	33,415	M	8·30	61	4,04,149	44,229	26,640	6·59	...	...
117	Chembrambankam tank	1871	The Kortalayar			100	38 11	3,043	5,729	...	24,478	19,065	14,347	12,163	3,067	15,230	E	25	27	7,45,573	25,677	26,044	3·49	...	...
118	Madras water-supply and irrigation extension project.	1857	Ditto			34	63 50	2,745	5,378	...	10,165	10,543	8,171	7,472	2,385	9,857	...	30	10	17,54,045	29,459	24,577	1·40	...	...
119	Tirukkoilur ,,	1862	The Ponniar	...	...	...	...	...	...	1,271	42,985	27,998	24,351	22,685	3,003	25,688	M	6	137	2,59,170	56,352	18,247	7·23	...	...
120	Mehemathur ,,	1872	The Manimuthanuddy	...	...	...	...	...	...	...	10,651	4,142	2,236	3,948	196	4,144	M	...	15	71,047	12,958	7,122	10·12	...	...
121	Vriddhachalam ,,	1869	Ditto	...	...	...	...	...	...	...	13,633	7,294	4,856	6,376	455	6,831	M	...	33	58,831	16,519	9,154	15·56	...	...
122	Palandorai ,,	1876	The Vellar	...	...	...	...	...	...	563	8,359	10,846	8,284	9,665	408	10,073	M	6·10	39	5,24,368	33,183	17,557	3·25	...	...
123	Maradur anicut	1873	The Tambraparni	...	...	...	...	...	...	...	17,920	35,104	27,421	17,553	16,819	34,372	M	...	27	44,177	73,651	56,573	128·06	...	...
	United Provinces.																								
	Betwa canal	...	River Betwa and Parichha reservoir	200 to 300	4	10,000	32	2,750	25,600	1,200	(a) 474,000	87,306	8,041	6,408	42,740	49,148	M	50	600	43,64,040	96,394	7,099	2·21	...	...

Jhansi Lakes.																								
125 Barwasagar	...	Rainfall on catchment.	...	...	...	32	324 million	999	15	11,373	1,942	562	122	1,051	1,173	Earth faced with masonry.	(*b*)	38	82,398	4,397	407	...	...	...
126 Pachwara lake	...	Ditto.	...	...	...		308 ,,	687	10															
127 Magarwara ,,	...	Ditto	...	...	...		59 ,,	204	5															
128 Kachneo ,,	...	Ditto	...	...	...		160 ,,	430	7															
Hamirpur Lakes.																								
129 Kirat sagar	...	Ditto	...	...	...	30	66 ,,	243	...	8,568	2,691	296	285	1,828	2,113	Earth faced with boulders.	...	28		5,776		...	...	...
130 Madan ,,	...	Ditto	...	...	...		68 ,,	344	6															
131 Kalian ,,	...	Ditto	...	...	...		17 ,,	104	3															
132 Bijanagar lake	...	Ditto	...	...	...		189 ,,	974	10															
133 Dasrapur ,,	...	Ditto	...	...	...		119 ,,	429	5															
134 Thana ,,	...	Ditto	...	...	...		112 ,,	453	5															
135 Tikamaw ,,	...	Ditto	...	...	...		14 ,,	61	3															
136 Belatal	...	Ditto	...	...	...		353 ,,	1,615	15															

(*a*) 414,000 in British Territory ; 60,000 in Native States.
(*b*) No records of these exist, the bands are generally from 20 to 30 ft. at highest spot.

LIST OF STATE IRRIGATION WORKS IN BRITISH INDIA WHICH WERE OPENED FOR IRRIGATION BEFORE 1st APRIL 1901—*contd.*

II. Works without Capital Account.

(1) *Punjab, Sind, Bengal,* and *United Provinces.*

Serial No.	Name of Work.	Year in which opened for irrigation.	Name of river from which supply is drawn.	Rabi supply in river. Average.	Rabi supply in river. Minimum recorded during rabi season.	Maximum discharging capacity of canal.	Total cultivable area commanded.	Areas irrigated annually during past ten years. Maximum.	Areas irrigated annually during past ten years. Minimum.	Average area annually irrigated during the five years ending 1900-01. Kharif.	Average area annually irrigated during the five years ending 1900-01. Rabi.	Average area annually irrigated during the five years ending 1900-01. Total.	Total mileage of channels at end of 1900-01.	Average financial results for five years ending 1900-01. Gross revenue realized during year.	Average financial results for five years ending 1900-01. Annual net revenue.	Proposed extension. Additional cultivable area to be commanded.	Proposed extension. Probable cost.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Minor works for which capital accounts are not kept.													Rs.	Rs.	Acre.	Rs.
									Punjab.								
137	*Upper Sutlej Series.* Katora	1871	Sutlej.	...	...	4,370	586,548	290,134	126,830	106,504	80,303	186,807	571	2,67,828	64,016	7,500	8,350
138	Khanwah	*		4,900	2,650	4,390											
139	Upper Sohag	1855		...	...	2,486											
140	*Lower Sutlej Series.* Hajiwah	Not known.		4,600	3,452	900	905,152	33,800	19,119	9,079	16,177	25,256	34	*Vide* Chenab Inundation series which include figures for Lower Sutlej Canals.		16,000	30,000
141	Diwanwah	1831				600		39,528	11,833	15,724	11,822	27,546	58			3,000	30.000
142	Jamwah Khurd	1775				540		20,733	9 154	7,347	7,158	14,505	62			3,000	30,000
143	" Kalan	1775				600		26,563	7,189	8,033	8,776	16,809	90			3,000	30,000
144	Bahawalwah Mailsi	1753				800		32,364	8,291	10,119	11,791	21,910	91			...	...
145	Mahomedwah	1738				1,100		42,021	13,250	14,004	16,351	30,355	130			...	...
146	Bahawalwah Ladhran	Not known.				1,015		35,183	12,450	10,636	13,347	23,983	108			...	...
147	*Chenab Inundation Canal.* Makthal Canal	1830	Chenab	31,450	4,578	684	431,848	12,950	6,244	4,837	4,280	9,117	26	6,54,793 These figures include the Lower Sutlej Inundation Canals.	1,70,307	...	...
148	Durana Langana	1758				654		28,674	14,536	12,823	11,600	24,423	47			...	...
149	Wali Mahomed	1755				919		60,402	24,819	20,134	18,701	38,835	74			...	...
150	Sikandarabad Canal	1717				1,600		46,161	41,414	19,732	24,442	44,174	51			..	...
151	Gajuhatta	1808				850		35,956	24,759	12,485	17,357	29,842	46			...	...
152	Panjani	...				65		4,469	1,724	1,241	1,739	2,930	18			...	...
153	Sikandarwah Canal	1775				350		11,905	7,017	2 281	6,589	8,870	18			...	...
154	Indus Canal	*	Indus	9,439	...	9,589	300,000	222,565	139,116	120,133	60,658	180,791	713	3,74,470	1,22,057	200,000	14,76,000
155	Shahpur Canal, Provincial	1891	Jhelum	9,000	4,988	933	53,255	35,590	6,795	15,503	7,247	22,750	116	47,218	11,436	...	...
156	Kabul River Canal	...	Kabul River	...	...	212	28,246	...	...	...	...	26,547	65	...	...	11,251	4,56,469
	Muzaffargarh Inundation Canals:—																
157	Kot Sultan (Garku)	*	Indus.	...	...	216	642,293	16,257	11,085	6,320	6,525	12,845	142	4,07,162	1,69,856	...	...
158	Majassan			...	...	2,302		44,045	34,254	18,368	21,722	40,090	178				
159	Maggi			...	...	1,620		66,226	59,498	27,419	34,261	61,680	239				
160	Gutha			...	...	1,032		52,364	38,495	20,556	24,423	44,979	187				
161	Puran			...	...	920		50,993	28,792	19,841	23,180	43,021	232				
162	Surah			...	...	251		21,235	10,090	7,599	10,353	17,952	64				
163	Suleman			...	...	452		20,735	10,289	5,797	10,135	15,932	72				
164	Chenab Canals	...	Chenab	...	...	1,609	...	64,461	48,991	20,951	36,403	57,354	239	...	...	..	...
									Sind.								
	Works in Left Bank Division:—																
165	Canals in Northern Hyderabad Canals	...	...	...	...	...	1,424,663	363,711	149,125	144,539	25,581	170,120	639	3,37,263	2,15,397	736,000	57,07,394
166	Canals in Central Hyderabad Canals	...	...	...	...	..	654,800		135,209	133,239	12,993	146,232	529	2,58,199	1,68,959	67,000	6,05,399
167	Canals in Fuleli Canals	...	.	...	...	...	101,400	31,010	18,522	23,611	2,146	25,757	148	60,185	16,582	...	...
	Other Canals, Northern Hyderabad District:—																
168	Bhur Large			...	...	78	3,880	2,644	664	1,011	206	1,217	3	...	...	...	...
169	Mirwah Sehro			...	...	27	8,350	6,252	1,927	2,703	1,163	3,866	7	...	...	...	...
170	Bhorsi		...	...	...	76	6 500	6,373	1,446	2,035	706	2,741	6	..	...	...	...
171	Jeo		...	...	...	19	700	443	61	145	69	214	3	...	...	...	...
172	Gharo Ali Bahr Myb		..	...	...	418	6,200	3,701	784	1,420	783	2,203	16	...	...	...	...

* Taken over at annexation.

173	Khah	Ancient.	...	...	...	214	3,040	1,533	769	869	183	1,052	3	...	...	...	...
174	Dambro		...	...	...	345	35,800	16,211	5,166	9,768	1,408	11,176	67	...	...	...	...
175	Other Canals, Central Hyderabad District and Ghari Fatehpur		...	...	...	245	13,971	2,169	738	1,426	156	1,582	9	...	...	...	...
176	Sadarang		...	...	...	272	14,040	2,505	1,351	1,650	307	1,987	9	...	...	...	...
177	Darya Khan		...	...	...	687	31,875	3,555	1,681	1,912	339	2,311	9	...	...	...	...
178	Nurwah		...	...	...	297	527	322	69	51	138	189	1	...	...	...	...
179	Kari Shumali		...	...	...	2,359	253,654	33,119	31,457	31,092	1,179	32,271	193	...	...	...	...
180	Nasirwah		...	...	...	1,750	127,203	32,167	28,160	25,591	1,693	27,594	127	...	...	...	...
	Other Canals Fuleli Canals District :—																
181	Chandan		...	...	...	188	10,400	4,023	2,685	2,214	775	2,989	22	...	...	...	...
182	Mir		...	...	...	120	1,800	1,163	347	684	238	822	3	...	...	...	...
183	Wasing		...	...	...	107	2,400	1,511	816	1,204	82	1,286	4	...	...	...	...
184	Nur		...	...	...	138	2,500	1,329	657	1,168	83	1,251	4	...	...	...	...
185	Hassan Ali		...	...	...	221	8,500	3,755	2,225	2,930	93	3,023	17	...	...	...	...
186	Khair		...	...	...	249	7,000	2,917	1,139	2,102	41	2,143	13	...	...	...	...
187	Khokhar		...	...	...	113	2,900	754	353	485	10	495	5	...	...	...	...
188	Dhadhko		...	...	...	298	12,900	2,599	844	1,873	102	1,975	13	...	...	...	...
189	Mulchand		...	...	...	1,581	53,100	12,966	9,469	11,039	248	11,287	67	...	...	...	...
190	*Works in Right Bank Division*	...	...	...	...	...	2,872,693	795,351	532,747	578,269	149,142	727,411	1,797	17,85,472	10,41,325	...	...
	Bengal.																
191	Eden Canal	1883	Damodar	155	5	800	100,000	71,333	11,739	25,011	964	25,975	45	31,043	—26,410	...	...
	United Provinces.																
	Bhabar Canals :—																
192	Baramdeo Canal	1874 till 1878; then in 1896	Sarda	Not known, but ample	...	169	Uncertain			...	...	...	7	...	...	...	...
193	Chorgallia ,,	1869	Landhaur Nadi.	40	35	57	2,670			433	2,283	2,716	10	...	...	...	...
194	Golapar ,,	Not known.	Gola Nadi	130	100	111	7,076	Not known.	Not known.	2,536	5,176	7,712	26	...	...	...	...
195	Golawar ,,		Ditto			215	21,377			6,859	15,533	22,691	56	...	...	...	...
196	Kaladhungi ,,		Baur Nadi	25	20	35	5,706			1,430	3,198	4,628	8	...	...	...	...
197	Dechauri ,,		Ditto	22	12	37	2,370			...	...	...	7	...	...	...	...
198	Damola and Kamola Canals		Karrar Nadi	38	34	53	2,670			...	...	...	5		...	...	...
199	Kotah Canal		Daleka ,,	12	9	50	2,776			...	...	...	5	...	...	..	...
200	Pawalgarh ,,		Ditto	30	20	70	5,400			...	...	...	9	...	...	...	...
201	Kichari ,,	1895	Kichari Nadi	35	26	43				...	...	...	8	...	...	...	...
202	Belgarh ,,	Not known.	Kosi ,,	179	143	30	2,714			6,153	10,221	16,374	6	...	...	...	...
203	Kosiwar ,,		Ditto			350	14,254						44	...	...	...	...
	Tarai Canals :—																
204	Donasagar Canal	Have been in existence for about a century.	Rainta Nadi	11	9	30				1,323	614	1,937	31	...	..	...	...
205	Mahadeo ,,		Bahila, Gaihna and Pathri Nadis.	150	100	130				2,630	1,544	4,174	45	...	...	...	...
206	Kundesri ,,					40	..	13,660	5,694	847	540	1,327	28	..	...	...	...
207	Bazpur Canals		Pathri, Lebra Gandi and other small Nadis.		.	..	32,601	12,933	4,093	5,727	1,923	7,650	67	..	...	...	...
208	Jeonar Canal		Jeonar and Kaknala Nadis.	40	30	120											
209	Khajjia ,,		Khajjia Naddi	35	20	62											
210	Bhakra ,,		Bhakra ,,	90	60	75											
211	Kakersen, etc.		Kakersen, Andhna and other small Nadis.	...	...	...	30,286	20,932	11,671	10,659	6,591	17,550	79	...	..	...	...
212	Rudarpur Guls		Dimri, Bahgul, Baghaia and Maddin Nadis.	..	...	..	22,794	16,534	9,241	5,370	6,000	14,370	74	...	...	...	..
213	Katna Canal		Katna Naddi.	...	...	70	6,238		...	...	..	...	24	...	...	..	...
214	Bilheri Canals		Chiefly Lohiya Nadi.	..	...	...	12,976	913	26	396	37	433	31	...	...	...	...

* Does not include Fatehpur.

LIST OF STATE IRRIGATION WORKS IN BRITISH INDIA WHICH WERE OPENED FOR IRRIGATION BEFORE 1ST APRIL 1901—*contd.*

II.—Works without Capital Account.—(2) *Bombay, Madras,* and *Upper Burma.*

Serial No.	Name of District.	Number of Works.		Average annual results during the five years ending 1900-01.						Remarks.
		Canals without storage work.	Tanks.	Gross receipts.	Total expenditure.	Net revenue.	Area charged as irrigated.			
							Kharif.	Rabi.	Total.	
1	2	3	4	5	6	7	8	9	10	11
				Rs.	Rs.	Rs.	Acres.	Acres.	Acres.	
				Bombay Presidency.						
1,479	Ahmadabad	...	1,265	68,165	17,376	50,789	(Not known.)	(Not known.)	16,971	
3,370	Kaira	1	1,890	565	647	—82			122	
3,379	Panch Mahals	...	9	1,212	121	1,091			120	
4,252	Broach	...	873	3,004	16,411	33,943			920	
5,908	Surat	...	1,656	47,350					12,304	
6,003	Khandesh	93	2	1,41,317	62,191	79,126			21,274	
6,291	Nasik	2[illegible]6	2	80,901	15,600	65,301			15,845	
6,298	Ahmadnagar	...	2	714	35	679			118	
6,299	Poona	4	2	3,499	1,245	2,254			498	
6,300	Satara	...	1	658	168	490			111	
6,714	Belgaum	...	414	33,131	16,639	16,492			9,910	
6,730	Bijapur	...	16	5,922	970	4,952			1,439	
8,175	Dharwar	2	1,443	1,75,560	84,356	91,204			58,190	
8,179	Ratnagiri	...	4	3,664	1,183	2,481			1,319	
9,493	Kanara	...	1,314	Not available.	1,878	Not available.			Not available.	
				Madras Presidency.						
				Class III.—Works.						
9,503	Vizagapatam	10	...	54,014	5,439	48,575	21,803	17,007	38,810	
9,505	Salem	...	2	1,157	1,208	—51	388	417	805	
9,506	Chingleput	...	1	13,527	3,651	9,876	5,871	1,109	6,980	
9,511	South Arcot	5	...	63,383	9,148	54,235	12,634	3,548	16,182	
9,533	Coimbatore	22	...	1,45,195	6,129	1,39,066	25,954	20,770	46,724	
9,539	Tinnevelly	6	...	4,23,911	15,798	4,08,113	37,091	34,582	71,673	
				Class IV.—Works.						
12.449	Ganjam	313	2,597	1.22,117	35,306	86,811	124,283	4,914	129,197	
13,834	Vizagapatam	81	1,304	1,95,217	58,399	1,36,818	69,290	63,626	132,916	
15.195	Godavari	27	1,384	1,33,082	75,717	57,365	84,024	2,738	86,762	
15,600	Kistna	32	373	93,604	97,985	—4,381	33,557	465	34,022	
16,200	Kurnool	257	343	1,27,215	41,971	85,244	43,512	7,363	50,875	
18,297	Bellary and Anantapur	1,185	912	6,22,447	1,62,758	4,59,689	163,188	49,805	212,993	
21.790	Cuddapah	929	2,564	5,99,075	94,168	5,04,907	178,694	64,579	243,273	
22,435	Nellore	20	625	3,78,743	94,531	2,84,212	113,132	12,732	125,864	
25,026	Chingleput	294	2,297	7,60,057	1,79,742	5,80,315	332,123	52,844	384,967	
28,056	South Arcot	251	2,779	10.12,346	1,69.873	8,42,473	277,424	59,445	336,869	

LIST OF IRRIGATION WORKS IN BRITISH INDIA WHICH WERE OPENED FOR IRRIGATION BEFORE 1ST APRIL 1901—*concluded.*

II.—Works without Capital Account.—(*2*) *Bombay, Madras*, and *Upper Burma*—concld.

Serial No.	Name of District.	Number of works.		Average annual results during the five years ending 1900-01.						Remarks.
		Canals without storage work.	Tanks.	Gross receipts.	Total expenditure.	Net revenue.	Area charged as irrigated			
							Kharif.	Rabi.	Total.	
1	2	3	4	5	6	7	8	9	10	11
				Rs.	Rs.	Rs.	Acres.	Acres.	Acres.	
				Madras Presidency—concld.						
				Class IV.—Works—concld.						
32,057	North Arcot	1,150	2,851	7,35,866	1,55,045	5,80,321	203,304	90,359	293,663	
34,831	Salem	835	1,939	4,12,035	73,556	3,38,179	110,769	102,269	213,038	
35,030	Coimbatore	72	127	2,18,608	14,934	1,73,674	48,491	20,161	68,652	
36,174	Trichinopoly	153	991	5,52,440	1,47,828	4,04,612	124,619	46,906	171,525	
36,681	Tanjore	...	507	1,26,705	—48,126	1,74,831	54,055	4,877	58,932	
42,291	Madura	524	5,086	4,35,266	86,578	3,48,688	121,139	38,209	159,348	
44,558	Tinnevelly	145	2,122	8,02,773	1,47,500	6,55,273	141,798	81,067	222,865	
				Upper Burma.						
44,572	Mandalay	1	13	1,73,016	1,24,066	48,950	(Not known.)	(Not known.)	36,488	
44,614	Shwebo	1	41	2,65,005	42,638	2,22,367			86,772	*
44,640	Sagaing	...	26	1,312	131	1,181			248	
44,649	Kyaukse	8	1	5,49,109	3,99,995	1,49,114			127,518	
44,651	Myingyan	...	2	3,580	54,998	—51,418			1,055	
44,718	Meiktila	...	67	3,66,933	2,42,769	1,24,164			88,601	
44,762	Yamethin	...	44	1,06,715	69,694	37,021			33,587	
44,768	Minbu	2	4	1,46,647	2,70,124	—1,23,477			44,763	
44,774	Magwe	...	6	1,454	454	1,000			715	

G. I. C. P. O.—No. 993 I. I. C.—7-9-1903.—3,900—A. F. M, etc.

ب خانہ
جامعہ عثمانیہ

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۲۔ اساتذہ جامعہ عثمانیہ و کلیات ملحقہ و گزیٹیڈ عہدہ داران جامعہ
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جاری نہ کی جا سکینگی۔